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PROTOPLASMIC DYNAMICS.

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THE present general tendency of natural science is towards unification. Formerly it was truly "natural history," analytically descriptive and distinctive, while morphological classifications were formed on external resemblances known as analogies, or on internal structural analogies entitled homologies. But this stage of culture has passed its maturity, while the investigation of processes has introduced the natural, synthetic, explanatory stage, with its abundant results now appearing.

The derivation of the physical forces from each other by transmutation, and from chemical and mechanical actions, which they are capable of originating again, the development of organisms from protoplasm, a substance, which, with its functions, all have in common, and the doctrine of the evolution of species, present only some of the most important advances made toward a unitarian system combining all objects and operations together as they are derived from each other. While some chemists expect that organic chemical combinations may yet be obtained by uniting inorganic molecules in the laboratory as in the bodies of plants, and there are those who think with Haeckel that the very lowest living forms may arise by spontaneous generation from the higher carbon compounds, the physiologists have decided that there are chemical changes and physical forces associated with, and seeming to have a causal connection with, the production of organic powers and functions. But there can be no positive certainty of this transition unless we can show *how* and *why* it necessarily results. To effect this and to attempt to trace out the systematic

combination of some of the fundamental operations, whether physiological, mechanical, physical or chemical, as they exist in one continuous process pertaining to protoplasmic things, is my present undertaking.

I.—Protoplasm masses and molecules, or their parts, may be set in motion by the impact or attraction of active masses or molecules or atoms, without or within.

The agitations thus imparting themselves are various and, because communicative, may be regarded as excitants or incitive actions, already called stimuli or irritants. These include *mass-motions*, such as pressure, blows and friction; *molecular motions*, chiefly vibratory or oscillatory, as sound, electricity, light and heat; also *atomic motions;* and with these are the *attractions* belonging to these divisions of matter respectively, as gravitation (weight), cohesion and adhesion (osmotic, diffusive, capillary, &c.), and finally chemism. Important sources of some of these are the chemical reactions of oxygen, water, and the ingested nutriment, constituents with each other and with the protoplasm elements; others proceed from contact with the active materials of the environment; while the sun also continually contributes.

II.—All the above disturbing forces tend to cause the displacement, mutilation, fission or decomposition of molecules or their parts, which is especially easily accomplishable against weak combinations of ponderous, complex molecules, such as distinguish organic bodies.

III.—When molecules or their parts are thus separated, their combining powers are set free, and this liberation of attractional forces will be sustained by the continued operation of the original displacement forces, or may become, to some extent, self-propagated after their cessation by the disturbance (heat, &c.) resulting from recombination; for the impact of every union manifests itself in new disturbing force, which, in turn, may disband other attractions, from which further combinations follow.

An illustration of this self-sustained process is common in every form of combustion. The little heat-agitation applied to a very small part of the mass to be consumed, frees attractions there, which satisfy themselves by uniting with the ever-present oxygen, thereby generating more heat, sufficient to renew itself by inducing further chemical reaction so long as fed with the material for consumption.

IV.—These free combining powers, acting together, constitute plasma attraction or affinity, and are the force and source of organic power. Their mode of utilization we shall see further on.

Though strange indeed that attraction as the great fountain of power in organisms has been overlooked, it has probably remained so from lack of seeing the application of this most abundant of all forces to the driving of the vital machine, even as we were late in learning the use of the expanding power of steam. Without looking among the attractions for the propelling power, the impression has prevailed that if anything is necessary, more than the assumption of an independent vital force, it must be looked for in forces like heat and electricity, which are freed by chemical combination, and evidently are of great importance, especially in the higher organisms as communicative and excitive of agitations inducing the liberation of attractions which collectively constitute the immediate organizing and working power. Concerning this matter Herbert Spencer (Princ. Biol., Vol. I, pp. 55) says, "*We have as yet no clue to the mode in which molecular movement is transformed into the movement of masses.*"

Also in this connection three papers may be cited as fairly showing the chief facts and theories bearing on this question and respectively pertaining to the three kinds of active tissues of the higher organisms:

1. Engelmann. Die Flimmerbewegung. Jenaische Zeitschrift, Vol. IV, 1868.
2. Charles. The mode of Propagation of Nervous Impulses. Journal of Anatomy for October, 1879.
3. Armsby. The source of Muscular Power. Popular Science Monthly for October, 1879.

The first of these is an exceedingly important volume of investigations, showing the effects of chemical re-agents, and the physical and mechanical forces in accelerating or retarding, introducing or stopping the action of dead and living cilia, also affirming the constancy and fundamental importance of the *imbibitional swelling*, and the conclusions of others, that *like reactions are obtained from all the contractile tissues.*

The second defines the two propagation-processes attributed to nerve impulses; the *vibratory* hypothesis and the *chemical* hypothesis, giving the facts on which the latter is founded, with the conclusion that it necessarily partly includes the former.

The final decision will probably be that both these processes exist throughout the gray protoplasm of the nervous system, but that the chemical predominates in the ganglial cells, the vibratory in the axial plasma.

The third is a presentation of the chief facts and conclusions pertaining to its subject, and with such decided bearings on the topic before us that we must notice it more particularly. By way of introduction the following statements represent a doctrine which is now largely taught and accepted.

"The question of the source of muscular power is essentially a question concerning *transformation of energy*. The most characteristic distinction between plants and animals is, that the former *appropriate force from outside themselves, from sunlight, and store it up as potential energy in the various complex compounds which they form in;* while animals draw their supplies of force entirely from those compounds in which it has been stored up by plants, and from which it is set free again when they are decomposed in the organism."

"In a word, the plant converts the actual energy of the sunlight into the potential energy of organic compounds, the animal converts the potential energy of the organic compounds into actual energy, which manifests itself as heat, motion, electricity, etc.; in the plant the spring is coiled up, in the animal it uncoils, exerting an amount of energy equivalent to that which coiled it. One of the forms which this energy takes on is that of *muscular motion*, which we thus trace back to the *potential energy of food*, and through this to that great source of all energy to our earth, *the sun*."

"We are not, however, satisfied with knowing in this general way that it is *the food* we eat which *serves as a vehicle to convey to us our needful supply of sun-force*."

We agree that there is "energy of food," that "plants store up * * * * energy in the various complex compounds which they form in," but when it is called "sun-force" appropriated "from sun-light" and stored up, we dissent, for it is attractional force inherent in terrestrial matter independent of the sun, and from which probably none has been received since our globe was a part of her fiery mass. Similarly Professor Carpenter (Correlation and Conservation of Forces, pp. 404–5) speaks, "Thus in either case we come, directly or indirectly, to solar radiation as the main spring of our mechanical power; the *vis viva* of our whole microcosm." And thus too much power is now-a-days often attributed to the present influence of the sun and the undulatory

forces, and too little to the attractional forces of matter. The author speaks of the force several times as "potential" and "latent" energy, but these words in such connection are worth no more than blanks. This valuable conclusion agrees with that of Professor Flint (and others),—"All the facts seem to indicate that muscular force originates in *a splitting up of some substance in the muscle accompanied by the liberation of force*" (p. 822). The next conclusion should be that *combining power* is the only *immediate* force that can be freed by fission among muscle molecules. This will appear if we thoroughly understand the nature and relations of the powers in question, for it is necessary to distinguish all forces sharply into two groups: 1, the *attractional* (gravity, adhesion, cohesion, chemism), and 2, the *impactive* or momentum forces of masses, molecules and atoms (in mass-motions, sound, electricity, heat and light). Those of one group are *not convertible* into, but *oppose* those of the other, and while the latter set may, by opposition, often disengage the former, the latter are but the *recoil* (which may propagate itself) from the actions produced by the former group.

V. The plasma-affinity, which is the joint action of its freed attractions, is its imbibing force, exerting a hydraulic suction power, manifested in a circulation into the part affected and the resultant swelling of the same, from which all the mass motions of organisms proceed.

The initial movement is the circulation among the attracting molecules with its general direction toward the point where the greatest amount of chemismic power is being freed, and such as necessarily precedes chemical unions of dilute fluid constituents with those of fixed, elastic, porous bodies; for the matter imbibed consists of the water solution of oxygen, nutriment and disengaged plasma-molecules. Most common examples of expansive and circulatory movements resulting from combining power are not in their details parallel with those of the protoplasmic substance. The activities from heat and from affinities freed by heat in ordinary combustion, which naturally come to mind first, present an altogether different case. If the combining element, oxygen, was only in a solution permeating everywhere to act throughout the entire mass, the resultant activity would be, instead of a swelling of heated surrounding air, an expansion of the solid mass. And we must also remember

that the protoplasm contains, besides oxygen, many other reagents as its stored food-constituents; that there are also more of the volatile elements in its composition, which is more complex while its consistency is that of elastic viscosity. Further, the oxidation in organic fluids cannot be so intense and generates but a comparatively small amount of heat, so little that it is eliminated by conduction without appearing in such vast quantities as to induce a boiling or convectional circulation, while the chemical reactions of the organized plasma-components are exceedingly slow and weak, yielding but little heat.

The intersusception and interpolation of new matter into the plasma is by *imbibition*, which also is the method of ingestion of nutriment by the plasma of cells and the lowest organisms. This imbibition process is a well-established concomitant to all plasma-action, but while its value as a nutritive power determining the peculiarities of nutrition and growth has been esteemed, its great importance in the production of *mass-motions* has not become understood.

VI.—*Imbibitional swelling*, in some respects, simulates that resulting from inorganic absorption and diffusion, but is markedly different, especially since the engaged combining powers act stronger than those freed, so that it does not result in a dissolution or solution of the imbibing substance, while the increase of distension intensifies its tension and elasticity. To understand the possibility of this swelling without rupture of the chemismic bonds in organic bodies, we may have to regard their constituents as grouped into filamentous branches or a spongy mesh, in symmetrical order, and remember that they are certainly very complex, for, according to recent chemical theories, some of the albumenoid molecules may contain a thousand atoms.

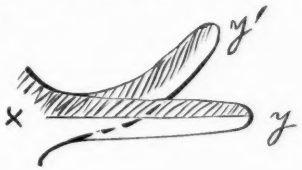
Let us now classify the principal *kinds of plasma-motion* while trying to explain how each is attained.

1. *Axial Procession.*—Let x—y represent a surface on which a lump of plasma is shown in section, the heavy portion of its outline indicating that part of its surface which is acted on by light or some other decomposing force. Imbibition from within to this tract is induced and it swells thereby advancing slightly toward the light, while gravity pulls it down so that an advancing descending movement of the front margin

results while the upper and inner adjacent plasma supplies its place to swell and follow, and so on, the mass advances. This kind of motion is very common in some Amœbas.

2. *Axial Exsertion.*—The imbibitional swelling may be still more local from either external or internal excitation and thereby produce pseudopodal protuberation, and in Amœbas we often observe the transition from the pseudopodal to the total procession. In both cases these animals show a marked circulation towards the swelling point in the protruding part.

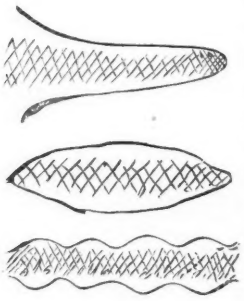
3. *Lateral Deflection* may be produced in any elongated mass by lateral superficial imbibitional swelling, as in the light area of the pseudopod x—y causing its deflection to x—y'. By this method alternating from side to side, the vibrations of the pseudopods of free-swimming, rotating rhizopods and the flagellate and ciliate action of infusorians, rotifers and other organisms are effected, probably under control of electro-chemical impulses in their own substance. The sort illustrated above may be called the monomeric while the polymeric or undulatory form also appears as shown in the figure, the white swollen regions being several and alternately disposed. Again, should the imbibition follow a spiral line, spiral contortions and cycloidal figures result.



A good method of showing imbibitional deflection is to use a very thin strip of gelatin, such as is employed by lithographers for tracings. Let a–b represent the sheet as seen edgewise and standing erect, held at a. Now if it be breathed on gently at the point indicated by the arrow, it will quickly bend over to b'. This is by imbibition of the moisture of the breath on one side causing it to swell. The thinner the sheet is the quicker will the flexure appear, and by comparison we may judge that with filaments as fine as cilia it should result with the same rapidity that characterizes cilia motion. The thin mass erects itself as promptly of its own accord, but still more sudden if moisture be breathed

on the opposite side. And thus by breathing on one side and then on the other the vibration back and forth may be produced several times. Of course, in actual cilia the conditions are very different, for the material to be imbibed is ever present, while the imbibitional attraction is alternately freed first on one side and then on the other apparently by a chemico-electric, electro-motor process. And those who think it necessary to suppose a vital force here must be reminded that, according to Engelmann (op. cit. pp. 463–4), weeks after death, on stinking, decaying membranes, the cilia can be set in action by adding their normal conditions of oxygen, water and temperature.

4. *Zonate expansion with axial contraction*, in a monomeric form pertains especially to such retractile parts as pseudopods, some cilia, and unstriated muscle cells, from imbibition in a zone of the conical or cylindriform part. The engorgement of this zone causes an influx into it shortening the long axis and tending to yield a spheroid form. In this way muscle cells and pseudopods broaden and shorten themselves, the latter sometimes to such an extent as to attain the diameter of the main mass, into which they thus merge. In the diagrams the light parts represent the expanding zones. With the polymeric form of the striated muscle cells, undulatory outlines result from the swelling of many successive zones giving greater and quicker contraction than in the smooth spindle cells. In this connection it must be borne in mind that a muscle's action is only a resultant of the joint action of all its cells and that attraction is the *vis a tergo* of organic expansion and contraction.



5. *Contra-actional retraction* we can presume as the reverse of the exsertive, its center of imbibition being at the base of the pseudopod which becomes drawn to it.

6. *Sphærogenic ballancement* would occur from equal expansion in all directions and cause the mass to assume a spherical form.

VII.—The processes described above produce all the *mass-motions* of organisms, which are of many kinds and may be chiefly grouped as:

1. *Locomotive*, for transporting individuals from place to place.

2. *Supportive*, for maintaining the normal relative position of parts and opposing gravity.

3. *Prehensional*, including all kinds of manipulatory actions.

4. *Peristaltive*, the motor actions of hollow organs on their contents, embracing swallowing, gastrition, peristaltition, the contractions of sphincters, the heart, blood-vessels (circulative), &c.

VIII.—The molar and mass-impact and frictional wear and tear from the above operations yield mechanical heat and electricity with structural degeneration.

IX.—To maintain the conditions of all these activities the combining process must go on intermittingly or constantly. The fractional molecules must unite with each other, with imbibed food-constituents (nutritive assimilation) or with oxygen.

X.—From this we have chemical heat and electricity with the processes of protoplasmic extraction, secretion and excretion of fluids. Though heat and electricity must naturally appear more or less from all the chemical unions in plasma of whatever tissues, we may look upon the oxidizing process as the greatest source of chemical heat, while the ganglial and muscle cells are to be looked upon as the batteries in which chemical combination generates most of the neural electricity. To illustrate the relations existing here, we may suppose the light to cause molecular agitation in the retinal nerve-ending and to propagate itself inward. Entering the ganglial plasma, it frees attractions, whence recombination results, generating nerve electricity discharged along the motor nerve and naturally causing some chemical reaction in it, but producing its greatest effect in the terminal muscle cell, which is charged as a receiver, the continued agitation keeping its attractions freed, sustaining imbibitional zonate expansion with axial contraction, from which mass-motion results. In the so-called voluntary motion it would seem as though the ganglial agitation was excited from within and the same consequences follow. The recombination occurring in the muscle substance probably also generates recurrent electricity, which reacts upon the nerve centers.

Finally, organic combining power is not only motor power, but also "growth-force," the *vis a tergo* of plasma-nutrition, growth and development, producing (by coöperation with conditioning forces) all the diverse and wonderful form-phenomena,

the kinds of which, like the varieties of mass-motion, are determined through localized imbibition. On this account, and because the motor acts have laid out the paths of growth, the parallelism between the series of morphological processes and of the motor processes is strikingly complete; but a presentation of these details, in the same order, must remain for the future.

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A SKETCH OF COMPARATIVE EMBRYOLOGY.

BY CHARLES SEDGWICK MINOT.

II.—THE FERTILIZATION OF THE OVUM.

IN the previous article we traced the relation of the genoblasts, or sexual products, to the cells from which they arise. We have now to consider the manner in which these products effect the creation of a new and complete animal. Now, the bodies of all animals are composed of cells and the productions of cells, hence to make an animal the first thing is to furnish cells. According to the theory propounded in the last article, an egg represents one part, a spermatozoön another part of a cell, hence a fusion of the two would again make a single perfect cell. This fusion actually occurs, and is called the impregnation or fertilization of the ovum.

Our knowledge of this phenomenon is extremely imperfect. It has, however, been the object of several important researches during the last few years, but we must wait for much more extended investigations before we can make any satisfactory generalizations. The following order of events is that which our present knowledge renders most probable—it must be remembered that we are dealing only with a probability. A *single* spermatozoön enters the egg and fuses with it. After the ejection of the polar globules, the nucleus of the egg is a small body which lies near the periphery, immediately underneath the globules. It then is called the *female pronucleus*, and travels—why or how is not known—towards the center of the egg, where it finally remains. A system of radiating lines runs out from it into the yolk, making, together with the pronucleus, the so-called female *aster*.

At some time during these changes, whether sooner or later perhaps does not matter, a single spermatozoön enters the egg. As the egg or yolk is surrounded by envelops, it is evident that either the spermatozoa must enter before the coverings are formed, or that it must have some way of passing them. For instance, in the hen the spermatozoa attain the yolk before the hard shell is formed in the oviduct. In other instances there is a special opening, often having a peculiar structure, which admits the passage of the spermatozoa, and is called the micropyle, Fig. 10. This opening is of course not an essential part of an egg, and merely permits the egg to be protected by an impermeable shell without excluding the spermatozoön. It is asserted that in some cases the micropyle is not a real opening, but only a permeable spot through which the spermotozoön can work its way (Kupffer).

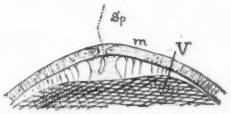

FIG. 10. — Spermatozoön entering the yolk of Petromyzon, the head having already traversed the micropyle; after Calberla.

It was stated above that only a single spermatozoön enters the yolk. The way in which the entrance of a second one is prevented is not definitely determined yet. It has, however, been stated by Fol and by Kupffer and Benecke that in the eggs observed by them (star-fish and lamprey) there is no vitelline membrane around the egg until after impregnation, when a complete envelop is rapidly formed by the yolk, effectually excluding all other spermatozoa. If this view is correct, then the egg has no proper cell membrane until after its fertilization; and all the coverings it has before that event, are only secreted around it by other cells, and not by itself.

When a spermatozoön penetrates into an egg, the head goes in first; after which the nucleus it contains loses its peculiar shape, transforming itself within the yolk into a small spherical or irregularly-shaped *male pronucleus*. The tail disappears—how is not known. This pronucleus, like the female, is surrounded by radiating lines, so that there is also a male *aster*. At this time the egg, as shown in Fig. 11, contains two pronuclei, and is still connected with the polar globules. The second pronucleus also travels towards the center of the egg, where the two pronuclei meet, both having meanwhile enlarged considerably. After coming in contact the two pronuclei fuse completely, making a

single body, to which the very appropriate name of segmentation nucleus has been given. Possibly a contraction of the impregnated egg always occurs, either during or immediately after the entrance of the spermatozoön, so that a space intervenes between the yolk and the envelops of the egg. As little heed has been paid to this point, we are uncertain about it.

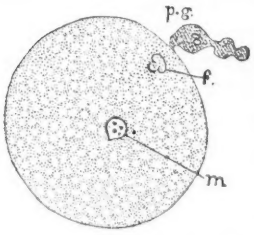

FIG. 11.—Egg of Nephelis three hours after laying. *m*, male,—*f*, female pronucleus; *p.g.*, polar globules; after Hertwig.

We thus have seen that a male and female element unite and make a single perfect cell. This fact offers a very strong support to the theory that cells contain two sexual constituents in a latent condition, and are therefore to be considered either hermaphroditic or sexless.

It has long been known that the egg of every animal must be impregnated by the spermatozoa of its own species, while on the other hand reproduction is dependent upon a certain dissimilarity, the existence of which is well established, although its nature cannot be even hypothetically explained. When the parents have been closely related for several generations, the sexual products alter in such a way that they cannot produce a complete animal by their fusion, although fusion with an element from another less closely related individual is still effectual. From these circumstances arises the necessity of cross breeding, a fact which has been so much discussed in public that I need not occupy further space to describe it. In a very few cases the genoblasts of nearly related species may unite efficiently, producing an animal partaking of the character of both parents—in short, a hybrid. Such exceptions are, however, extremely rare.

Since the offspring inherit the peculiarities of the parents, it is evident that the transmission must take place through the genoblasts, and various theories have been propounded to account for it, but no view has yet been brought forward which can justly be termed satisfactory, not even excepting the theory of pangenesis.

The formation of the impregnated egg, with its segmentation nucleus, marks the beginning of new cycle of life, for the cell so formed is endowed with a mysterious and remarkable power, which entirely distinguishes it from almost every other kind of cell known at present. The fertilized ovum is charged with forces

which cause it to divide into numerous cells, and cause these cells to arrange themselves upon the model of the parents which formed the egg and spermatozoa, and to imitate the peculiarities of the cells in each locality, making an eye where the parent had an eye, a gland where the parent had a gland—only the imitation is imperfect, the offspring is not absolutely the same as the parent. Evidently the fusion of the genoblast is the source of an increased vitality and of a formative power which is specific in each case, *i. e.*, the action and result of which is predetermined.

This marvelous formative power has always excited the interest and astonishment of naturalists. It is one of the fundamental distinctions of life, since no similar power occurs in inorganic nature. It is important to note, therefore, that it must enter into all cells, otherwise some of them would not form in the right place and manner. That other cells than the fertilized ovum contain such a power is shown by the formation of buds and strobila, and more strikingly by the development of *pseudova*. In the latter instance, the development begins with a cell arising in the ovary, and which resembles an ordinary egg very closely. Such cells are formed in various animals, notably in the plant lice, but, although they are so like eggs, the pseudova differ by being capable of developing into a complete animal without impregnation.

For want of space, it is impossible to describe the formation of buds and strobila, let it therefore suffice to say, that the reproduction depends in both cases upon the separation of a *cluster* of cells (instead of a single cell or pseudovum) from the body of the parent. This cluster grows up into a complete animal, in which the structure of the parent, or sometimes of the grandparent, is imitated by the action of the formative force of the cluster of cells. Hence it is evident that a similar power is bestowed upon several cells, which is the thesis we started to prove.

III.—SEGMENTATION AND THE FORMATION OF THE GASTRULA.

After the impregnation has been completed, and the two pronuclei have fused, to form the segmentation-nucleus, there usually follows a period of quiescence, during which no visible changes occur. It is not known whether such a period is always intercalated in the course of development; but it has been observed frequently. After this pause the process of segmentation begins, which has for

its essential purpose the multiplication of cells; the further history of the egg is a description of the way in which the cells, constantly on the increase, arrange themselves in definite order, until they have gradually created, or, more truly, become, the adult animal. The object of embryology is to discover the laws according to which this arrangement is developed.

We, of necessity, begin with a study of the process of segmentation; but the details are so numerous that we can indicate only a few of them. The first result is the formation of two sets of cells. In one set the cells are small; in the other set they are large. Except in the sponges, the small cells form the outside covering of the body, appearing as a sac, or vesicle. The large cells form the lining of the digestive canal, or primitive stomach, and are, therefore, enclosed in the outer vesicle made by the small cells. It appears that this disposition arises in two entirely distinct ways. First, the cells formed by segmentation arrange themselves in the shape of a sphere, hollow inside, and its walls consisting of a continuous layer of cells. One half is composed of small cells; the other half of large cells. Second, the result of segmentation is likewise a hollow sphere, but with double walls; the outer wall of small cells, the inner wall of large cells. In both cases the sphere transforms itself into a so-called *gastrula.* In the first instance, the large cells become inverted inwards, or, in technical language, invaginated; while the small cells grow down and around the others, until they encase them, leaving only a small opening, the primitive mouth. In the second instance, an opening breaks through both walls, thus making a mouth. This method of development is much rarer than the other, and unfortunately has never been studied in a thoroughly satisfactory manner.

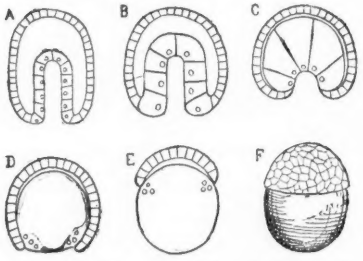

FIG. 12.—Diagrams of the principal modifications of the Gastrula. *cf.* Text. *A–E* represent sections.

The accompanying figure displays diagrammatically the principal forms of gastrulæ. *A* is a very simple form, such as occurs among Echinoderms. The difference in size between the two sets of cells is slight, but evident. In *B*, the difference is more marked,

and fairly represents a gastrula of *Amphioxus*. In *C*, the difference is very great, and corresponds to a form observed in certain Gasteropods. In *D*, the inner set is no longer separated into distinct cells, although there are a number of nuclei, each of which marks the center of a future cell. In such an instance we should regard the whole inner set as a nutritive yolk, not yet transformed into a definite cell-layer. This figure is particularly instructive, because it shows that what we call the yolk is not something distinct from the germ, but really belongs to the inner layer of the embryo. *E* shows a similar egg, in which the outer set of cells has not yet grown around the yolk. This outer layer was called by the earlier embryologists the blastoderm, in all those eggs with a great deal of yolk. *F* shows the same egg not in section, but seen from the outer surface, to exhibit the cap of small cells, or the blastoderm, resting upon the large yolk. Those eggs in which the difference in size between the two sets of cells is not excessive (A–C) are called *holoblastic*, while those in which the yolk remains more or less intact for a considerable time (D–F) are termed *meroblastic*.

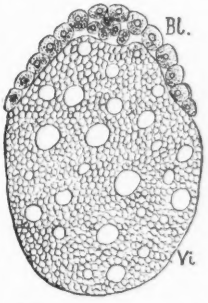

FIG. 13.—Formation of the blastoderm in *Oniscus murarius*, after Bobretzky.

In order more fully to illustrate the peculiarities of the process of segmentation, it is necessary to consider the holoblastic eggs further. Fig. 13 represents an actual section of an egg of the sow-bug, *Oniscus*, after Bobretzky, corresponding very nearly to the diagram *E*, of Fig. 12. Fig. 14 is a similar section through the egg of a moth (*Pieris crataegi*), and shows a number of nuclei, each surrounded by a little mass of protoplasm, and scattered irregularly through the yolk. Their number gradually increases, and each one becomes the center of a distinct cell. This is merely a peculiar modification of the ordinary method of cell division into two equal parts, for in the moths and butterflies and some other animals the large yolk divides gradually, by forming several nuclei, and so breaking up into a considerable number of cells piled up one over the other. We shall have oc-

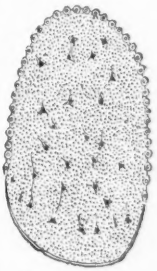

FIG. 14. — Section of a segmenting egg of a moth; after Bobretzky.

casion to recur to this matter in speaking of the development of vertebrates.

The embryology of sponges is important because they do not have any gastrula. It will be described in our next article. Except in the sponges, the small cells form the outside layer and are called the *ectoderm*, while the large cells form the inside layer, or *entoderm*. In England the attempt has been made to substitute epiblast for ectoderm, and hypoblast for entoderm, but the change seems to me useless and confusing. In face of the present tendency to substitute new and difficult for old and simple names every protest is desirable. Compounding English polysyllables from Latin and Greek confers, in most cases, no benefit to science. The coining of such terms ought to be restricted in its application to things which have no accepted name and for which no straightforward English term can be found.

The next progress after the formation of the ectoderm and entoderm does not occur among all animals, but only in those above the Cœlenterates. I refer to the development of a distinct middle layer of cells, the *mesoderm*, situated as shown in Fig. 15, between the two primitive layers. Of the origin and characteristics of the mesoderm I shall treat in the next article.

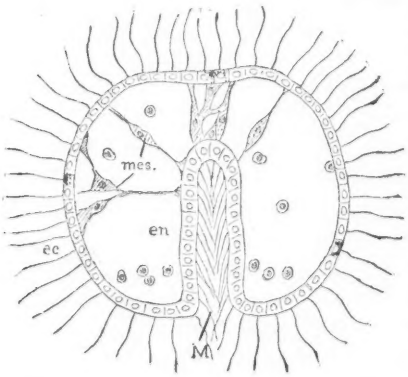

FIG. 15.—Section of a gastrula of *Toxopneustes lividus*, after Selenka; *mes.* mesoderm.

A great many embryos live in the water, and have the power of locomotion long before they have any muscles. For this purpose the ectoderm in these forms is provided with cilia or vibratile hairs, which may be longer (Fig. 15) or shorter. In most free embryos, moving by cilia, we find distinct bands, along which the cilia are more developed and powerful; as the ciliated bands are often pigmented, while the rest of the embryo is transparent or light-colored, they are very conspicuous. We shall have to recur to them.

The authorities for the general views advanced above are the

discussions in a long series of special papers. Prof. Haeckel[1] has written a great deal upon the gastrula and its significance, and has published several popular works on embryology. Unfortunately, he is inaccurate and untrustworthy to a degree surpassing any other scientific writer I can recall, for on almost every page are mistakes it requires little knowledge to detect. He is, therefore, utterly useless to the beginner. I mention this, not alone as my personal conviction, but also as the judgment of competent and distinguished critics, some of whom are even more severe in their condemnation. For these considerations I shall not quote Haeckel as an authority. The references to some of the special papers I have consulted will be given hereafter.

E. General papers on the Germ layers.

31. Agassiz, Alexander. Critique de la Gastræa theorie. (Traduit par Schneider.) Arch. Zool. expt. Tome IV, p. IX (1875). Also Mem. Amer. Acad. X, No. 3.

32. Lankester, E. Ray. On the Primitive Cell Layers of the Embryo, etc., etc. Ann. and Mag. of Nat. History, Vol. XI (1873), p. 321–338.

33. ——. Notes on the Embryology and Classification of the Animal Kingdom, etc. Quart. Journ. Micros. Sci. 1877. p. 399.

34. Minot, C. S. Recent Investigations of Embryologists, etc. Proc. Boston S. N. H. Vol. XIX, p. 165. (A brief summary.)

35. Moquin-Tandon. De quelques applications de l'Embryologie à la classification méthodique des animaux. Ann. Sci. Nat. Zool., II (1875), Art. 7.

36. Salensky. Bemerkungen über Haeckel's Gastræatheorie. Archiv f. Naturges. Bd. I. Jahrg. 40 (1874).

37. Semper, Carl. Kritische Gänge. No. III. Die Keimblätter theorie. Verh. phys. med. Gesell. Würzburg. Bd. (1873), p. 222.

[1] "Professor Haeckel's principal articles on the Gastrula are to be found in the *Jena Zeitschrift für Naturwissenschaften*, Band. VIII, p. 1, and *Biologische Studien*, 2tes Heft. 1877. Haeckel introduced the term *Gastrula*, and his writings and speculations have afforded a powerful stimulus to embryological research."

PROGRESS OF INVERTEBRATE PALÆONTOLOGY IN THE UNITED STATES FOR THE YEAR 1879.

BY DR. C. A. WHITE.

AS the operations of men's minds are not subject to the calendar, it is difficult to select any specified period of time and say just what progress in any one branch of investigation has been made within it. Therefore, in this popular review of American palæontological labors for 1879, both the distal and proximal boundaries of the year will be held somewhat loosely. That is, in giving a summary of the work done, all writings will be mentioned which have been published either originally or in their latest form, even such as appeared in the earliest days of the year; and mention will be made, not only of such works as are known to be in press at the close of the year, but also of such as are known to be in course of preparation then. These anticipatory notices have been made from information kindly communicated by the various authors who are referred to. No work, however inconspicuous, has been intentionally omitted from bibliographical notice, but even the most obscure are mentioned, leaving the question of sufficiency or insufficiency of publication to be decided by the custom of naturalists. The writer, in connection with Prof. H. Alleyne Nicholson, having published a Bibliography of North American Invertebrate Palæontology, which, with a supplement, extended to the close of the year 1878, the following account of the publications for 1879 may be made, to serve rudely as a continuation of the portion of that bibliography which relates to the United States. The reader may readily separate this bibliographical matter from the personal gossip, of which the article is largely composed.

The list of Americans now living who have at some time or other, and to a greater or less extent, contributed to the literature of invertebrate palæontology, is a rather long one, and yet the names of a large majority of them do not appear in connection with any publication of the past year. Among the active workers in this field is first to be mentioned the veteran palæontologist, Prof. James Hall, who is still engaged with his great series of works for the State of New York, upon which he has bestowed the unremitting labor of almost forty years, no one of which has been more fruitful of important results than the one just passed.

Volume v of his great series is just completed, and will, doubtless, be in the hands of scientific workers within a few weeks. It is in two parts—really two volumes—part I containing the text, and part II the plates. I regret that it has not been practicable to obtain a résumé of the contents of this volume, but it is safe to say that it is a worthy companion of any one of the series which has preceded it, the appearance of each one of which has marked an epoch in the literature of American palæontology. In 1862 Prof. Hall published in the Transactions of the Albany Institute, descriptions of a large and remarkable collection of Niagara fossils at the then newly-discovered locality near Waldron, Indiana. In 1876 he published in the documentary edition of the Twenty-eighth Report of the Regents of the University of New York, full illustrations of these fossils, but without any accompanying text. In the museum edition of the Twenty-eighth Report, just printed, Prof. Hall publishes full descriptions of all those fossils, together with the republished illustrations, embracing more than one hundred pages of text. In March of 1879, he also read before the Albany Institute, "Descriptions of New Species of Fossils from the Niagara Formation at Waldron, Indiana." This work is now published in the form of a twenty-page pamphlet, and contains descriptions of upward of forty new species and one new genus. *Ampheristocrinus*. Palæontologists will rejoice that this remarkable fauna of the Niagara period is at last fully before them. In addition to the descriptions and illustrations of the Niagara fossils, Prof. Hall also publishes in the Twenty-eighth Report just mentioned, a paper, illustrated by three large plates, entitled "Notice of some remarkable crinoidal forms from the Lower Helderberg Group." He here establishes the new genus *Camarocrinus*, of which he describes three species. A part of the remarkable fossils upon which this paper is based have been in the hands of Prof. Hall for many years; and a part of them were lately collected in Tennessee by Prof. J. M. Safford, who read a paper on them last summer at the Saratoga meeting of the American Association for the Advancement of Science. Besides these important works, Prof. Hall has a brief illustrated article on the genus *Plumulina* in the Thirtieth Report of the New York State Museum, just published, and he also read a palæontological paper at the Saratoga meeting of the American Association for the Advancement of Science. The Thirty-second

Report of the New York State Museum is in press; it contains descriptions of the Bryozoa of the Lower Helderberg group, adding fifty or sixty species to the list of those published in a former report; all being the work of Prof. Hall.

The time of Prof. R. P. Whitfield, for the past year, has been largely employed in his duties at the American Museum of Natural History at New York, and at the Troy Polytechnic Institute, but he has, meantime, continued his work upon the Palæontology of the States of Ohio and Wisconsin, the results of which are to appear in Vol. III of the former and Vol. I of the latter, respectively, both of which volumes are well advanced toward completion. At the Saratoga meeting of the American Association for the Advancement of Science, he read a paper on the Occurrence of rocks representing the Marcellus shale of New York, in Central Ohio; and published in the September number of the *American Journal of Science and Arts*, p. 22, a note on the Occurrence of *Maclurea magna* in the Barnegat (Chazy) limestone near Newburg, N. Y. These are brief papers, but they are important applications of palæontological identification of fossil forms to the elucidation of geological problems.

Besides these, he has published in the same journal for January, 1880, pages 33–42, an article on "New Forms of Fossil Crustaceans from the Upper Devonian of Ohio," in which he proposes the genera *Echinocaris* and *Palæopalæmon*, describing three new species under the former, and one under the latter genus. He has also prepared a description and figures of a large and interesting Cretaceous brachyuran crustacean, *Paramithrax (?) walkeri*, which will appear in connection with the palæontological work of the writer of this article, in the Annual Report for 1878 of the U. S. Geological Survey, lately in charge of Dr. Hayden. His work for the Palæontology of Ohio will be illustrated by from fourteen to eighteen plates of figures. One of these plates will be devoted to the illustration of his new forms of Devonian Crustaceans already mentioned, and one of them, in part, to the illustration of those forms upon which he bases his conclusions of the occurrence of Marcellus shale in Ohio, also before mentioned. The report will contain descriptions of new and known forms from the Lower Helderberg, Upper Helderberg and Upper Devonian; also the entire known fauna of the Maxwell limestone (=Chester and St. Louis series) and some other upper and lower

Carboniferous forms, some of which are referred to the horizon of the Burlington limestone.

His work on the Palæontology of Wisconsin is now ready for the printer and engraver, and will be issued some time during the year 1880. A total of one hundred and eighty-nine species are illustrated by twenty-six plates of figures, which fossils are referred to the following formations: Potsdam, Lower Magnesian, Trenton and Galena, Hudson River, Niagara, Guelph, Lower Helderberg and Hamilton.

He recognizes *Triplesia*, *Holopea* and *Bellerophon*, and a second species of *Palæacmæa* in the Potsdam; and also *Ellipsocephalus* and the peculiar genus *Aglaspis*, of Hall, in the same formation, thus adding materially to our knowledge of the fauna of the Potsdam period, and to the previously known range of some of the genera mentioned. The Lower Magnesian epoch he finds represented in Wisconsin by the genera *Dikellocephalus*, *Illænurus*, *Metoptoma* and *Scævogyra*, the latter being a new genus of sinistral gasteropods. He also proposes a new genus of corals, *Cystostylus*, among the fossils of the Niagara group. His palæontological recognition of the Guelph limestone in Wisconsin, is important; and he also describes new forms from that formation. Some of the species recognized as new among the Wisconsin collections have been described by Prof. Whitfield in the published annual reports of that survey, but about thirty of them are published in the forthcoming volumes for the first time. These works of Prof. Whitfield, all of which are practically finished, will become an important part of the palæontological literature of our country.

The labors of Mr. S. H. Scudder in invertebrate palæontology are confined almost wholly to fossil insects, but he has performed this work so well, and prosecuted it so vigorously, that no one seems disposed to dispute the ground with him. He is still busily engaged with his great work on the Tertiary insects of North America, which is now well advanced toward completion, and is to form Vol. XIII of the quarto series of the U. S. Geological Survey of the Territories, lately in charge of Dr. Hayden. His memoir on the Palæozoic cockroaches has just issued in quarto form from the press of the Boston Society of Natural History, in which about sixty species are enumerated and figured. A memoir in the same form and from the same press, on Early Types of

Insects, has also lately issued, and an abstract of it has appeared in the January (1880) number of the *American Journal of Science and Arts*, pages 72-74. An interesting article from his pen has also lately appeared in the Report of Progress of the Geological Survey of Canada for 1877–1878, pages 175–185, on "The Fossil Insects collected in 1877 by Mr. G. M. Dawson in the interior of British Columbia." The insects described are all referred to the Tertiary period, and represent four orders; one species being referred to the Hymenoptera, two to the Diptera, ten to the Coleoptera and four to the Hemiptera. Among the latter he proposes the new genus *Planophlebia*.

The duties of Prof. A. Hyatt at the Museum of the Boston Society of Natural History, have made such demands upon his time for the past year, as to retard the progress of his special investigations. He is still working, however, upon the Ammonites, being now specially engaged upon the *Arietidæ*, and also upon the Steinheim shells. His only published work for the past year is embraced in a paper, by the writer of this article, on "Fossils of the Jura-trias of South-eastern Idaho," in the Bulletin of the U. S. Geological Survey of the Territories, Vol. v. Prof. Hyatt there proposes and diagnoses the new Cephalopod genus *Meekoceras*.

Mr. W. H. Dall published in the Proceedings of the U. S. National Museum, Vol. 1, page 3, an interesting note on the occurrence of a Post-pliocene deposit containing recent species of marine shells in a semi-fossilized condition, at the head of a cañon near San Luis Rey, California, twelve miles from the sea and six hundred feet above tide water.

This determination of species is especially interesting and important, since it proves a considerable elevation of that coast to have taken place at a comparatively recent date. He also published in the same volume, pages 10–16, an article on "Fossil Molluscs of the Later Tertiary of California," describing six new species, and giving a table showing the known distribution of forms and the proportion of fossil and recent species respectively.

Mr. Angelo Heilprin has published in the Proceedings of the Academy of Natural Sciences at Philadelphia for 1879, three articles bearing respectively the following titles: "On some new Eocene Fossils from the Claiborne marine formation of Alabama;"

"A comparison of the Eocene Mollusca of South-eastern United States and Western Europe in relation to the determination of identical Forms," and "Stratigraphical evidence afforded by the Tertiary Fossils of the Peninsula of Maryland." The first of these papers is illustrated by a plate of figures; the other two embrace some important philosophical discussions. Mr. Heilprin has begun the preparation of a monograph of the Tertiary Fossils of Eastern North America.

George Jennings Hinde, Esq., F. G. S. of Surrey, England, published in the Quarterly Journal of the Geological Society for August, 1879, pages 352–369, an important memoir "On Conodonts from the Chazy and Cincinnati group of the Cambro-silurian, and from the Hamilton and Genesee Slate divisions of the Devonian in Canada and the United States." Palæontologists have been divided in opinion as to what class of animals these interesting remains belong to, and Mr. Hinde's important memoir still leaves us in doubt upon this point, although he has much enlarged our knowledge concerning the objects themselves.

In 1878 Mr. U. P. James began, at Cincinnati, the publication of *The Palæontologist*, for which he is thus far the only writer. Four numbers have been printed, aggregating thirty-two pages octavo, two numbers of which have appeared in 1879. In these two numbers Mr. James describes twenty-one new forms of Lower Silurian fossils, and proposes two new fucoid genera, *Saccophycus* and *Lockeia*.

Mr. Victor W. Lyon described three new forms of *Calceola* from the Upper Silurian rocks of Kentucky, in the Proceedings of the Academy of Natural Sciences at Philadelphia for 1879, pages 43–46.

Mr. S. A. Miller has, during the past year, published in pamphlet form, of thirty-five pages, a revision of his "Catalogue of Fossils found in the Hudson River, Utica Slate and Trenton groups, as exposed in the south-east part of Indiana, south-west part of Ohio and northern part of Kentucky," which originally appeared in the Tenth Annual Report of the Geological Survey of Indiana. In the April number of the Journal of the Cincinnati Society of Natural History, pages 31–42, he has "Remarks upon the Kaskaskia group, and descriptions of new species of Fossils from Pulaska county, Kentucky;" the new forms being illustrated, with others, upon the two plates which that number

contains. In the July number of the same journal, pages 104–118, Mr. Miller has "Descriptions of twelve new Fossil species, and remarks upon others." The species are from the Hudson River, Niagara and Upper Helderberg groups, all being echinoderms except one fucoid, and all are illustrated upon the two plates which accompany the number.

Prof. James M. Safford read a paper at the Saratoga meeting of the American Association for the Advancement of Science, on some remarkable Crinoids from Tennessee, which form the subject, in part, of the article by Prof. Hall in the lately published edition of the Twenty-eighth Regent's Report, and which has already been mentioned.

Mr. E. O. Ulrich has, in the April number of the Journal of the Cincinnati Society of Natural History, an illustrated article entitled "New genera and species of Fossils from the Lower Silurian about Cincinnati. He describes thirty-two species, and proposes three new genera, *Lepidolites*, *Ropalonaria* and *Crateripora*. In the October, 1879, number of that Journal, pages 119–134, he has two articles entitled, respectively, "Description of a new genus and some new species of Bryozoans from the Cincinnati Group;" and "Description of a Trilobite from the Niagara Group of Indiana," both being illustrated. He has also lately personally published a thirty-two page pamphlet, "Catalogue of Fossils occurring in the Cincinnati Group of Ohio, Indiana and Kentucky."

Lieut. A. W. Vogdes, in "Notes on the Geology of Catoosa county, Georgia," in the December number (1879) of the *American Journal of Science and Arts*, page 477, names and briefly characterizes *Calymene rostrata*, a new Upper Silurian trilobite.

Messrs. Charles Wachsmuth and Frank Springer have published, in the last number for 1879 of the Proceedings of the Academy of Natural Sciences of Philadelphia, a "Revision of the Palæocrinoidæ. Part 1. The families Ichthyocrinidæ and Cyathocrinidæ." Those who have done original work with the palæozoic crinoids, or attempted a critical study of them, can fully appreciate the importance of the work which has been undertaken by these authors. The portion now published is the first of a proposed series, and contains about one hundred and fifty pages and three plates of illustrations. It contains a discus-

sion of the general subject and of the questions pertaining to the two families now considered; a rearrangement of the genera and sub-genera under each, and lists of all the known species of each genus with their synonymy.

Mr. C. D. Walcott, in four pages printed in advance of the Thirty-second Annual Report of the New York State Museum of Natural History, publishes "Descriptions of new species of Fossils from the Calciferous formation," embracing five new forms. He has also published a pamphlet of thirty-eight pages and two plates, in advance of Vol. x, Transactions of the Albany Institute, with the triple title, "The Utica Slate and Related Formations; Fossils of the Utica Slate; and Metamorphosis of *Triarthrus becki*." In these papers Mr. Walcott presents some interesting discussions, makes known important facts bearing upon the subjects indicated by the titles, and proposes the genera *Cyathophycus* and *Discophycus*. The Thirty-first Annual Report of the New York State Museum has lately been issued, which contains the final publication of Mr. Walcott's papers, "Notes on some sections of Trilobites from the Trenton limestone;" "Note upon the Eggs of the Trilobite," and "Descriptions of new species of Fossils from the Chazy and Trenton limestone." Mr. Walcott has also much important material in hand, which will, when published, add largely to our knowledge of the anatomy of the Trilobite.

In the January (1879) number of the Journal of the Cincinnati Society of Natural History, Prof. A. G. Wetherby has an article entitled, "Description of a new family and genus of Lower Silurean Crustacea," which is illustrated by eight figures on plate 7 in the April number of the same journal. The proposed new family and genus (*Enoploura*) are founded on the *Anomalocystites* (*Atelocystites*) *balanoides* of Meek, which Prof. Wetherby removes from the Cystidians, where it was placed by Meek, to the Crustacea. He also publishes in the April number of that journal, some interesting remarks upon the genus *Pterotocrinus* Lyon and Cassidy, with illustrations. He thinks the genus more nearly allied to *Eucalyptocrinus* than any other, and not nearly related to *Dichocrinus*, as has been formerly supposed by some palæontologists. In the October number, pages 134–140, Prof. Wetherby has "Descriptions of new species of Crinoids from the Kaskaskia group of the Sub-carboniferous," with one plate of illustrations. He has also in press, a revision of certain species of Crinoids which have been referred to the genus *Zeacrinus*.

Professor A. Winchell has an investigation of the Cephalopods of Tennessee nearly completed, and is also pursuing his investigations of the Stromatoporidæ.

The writer of this article has published in Vol. v, of the Bulletin of the United States Geological Survey of the Territories, the three following "Palæontological Papers:" No. 9—"Fossils of the Jura-trias of South-eastern Idaho," pages 105–118; No. 10—"Conditions of Preservation of Invertebrate Fossils," pages 130–142, and No. 11—"Remarks upon certain Carboniferous Fossils from Colorado, Arizona, Idaho, Utah and Wyoming, and certain Cretaceous Corals from Colorado, together with descriptions of new Forms," pages 209–221. He has also in the same volume, pages 143–152, in connection with Prof. H. Alleyne Nicholson, a supplement to the Bibliography of North American Invertebrate Palæontology. The March number of the *American Journal of Science and Arts* also contains an article from his pen entitled, "Remarks on the Jura-trias of Western North America."

The most important of these papers is No. 9, relating to the discovery of Triassic types in the region indicated, the epoch of the Muschelkalk of Europe being fully recognized. It is in this paper that the new genus *Meekoceras* of Hyatt is diagnosed.

The writer has also in press a series of Contributions to Invertebrate Palæontology, seven in number, illustrated by thirty-eight lithograph plates. The first portion with ten plates has just been published separately, and is to appear in the Annual Report of the U. S. Geological Survey of the Territories for 1877, and the remainder in that for 1878. The fossils described and illustrated are from the following formations: Carboniferous, Triassic, Jurassic, Cretaceous, Laramie and Tertiary. A large proportion of these species have been described by the writer in different publications of the surveys, formerly in charge of Dr. Hayden and Prof. Powell respectively; a part are therein described for the first time, and the remainder are species that have, by different authors, been described in various publications, but not illustrated. These descriptions last referred to are mostly by the late Mr. F. B. Meek and Dr. B. F. Sherward. It has been the aim of the writer to illustrate all the species described by these two authors as well as others, so far as practicable; and when the volumes in question appear, there will remain comparatively

few described species from strata of the western half of our country that will not have been illustrated.

Besides the foregoing, the writer has also in press, for the Proceedings of the U. S. National Museum the following articles and notes: "Descriptions of new species of Carboniferous Invertebrate Fossils;" "Descriptions of new species of Cretaceous Fossils from Kansas and Texas;" "Note on the occurrence of *Productus giganteus* Martin, in California," and "Note on *Criocardium* and *Ethmocardium*." The three first-named papers are illustrated by seven plates of figures. In the first paper is proposed the new Crinoid genus *Lecythiocrinus*, from the Upper Coal measures of Kansas. In the second, two species are described from the Dakota beds of Kansas, collected by the late Prof. Mudge, adding to our knowledge of the fauna there, which links the lower American Cretaceous with the upper much more closely than was formerly supposed. The discovery of that huge brachiopod, *Productus giganteus*, in the western part of the continent, where it has hitherto been unknown within its limits, is an interesting fact. The sub-genus *Ethmocardium* is proposed in the last-named paper for a *Cardium* (*C. speciosum* Meek and Hayden), which is without spinules, and has rows of cleanly-cut holes through the entire thickness of the test, which occupy the spaces between the ribs of the middle portion of the shell.

Among the many important facts brought out in the "Contributions," it is there shown that many of the types by which the living North American land and fresh-water molluscan fauna is characterized, have descended to us almost entirely unchanged from the Laramie period and, in some cases at least, from the still earlier Cretaceous epochs. Even some of the sub-divisions of genera, made by different authors, and which some others have been slow to accept, as insufficiently founded, are found to have become established in those early times, and to have maintained their slightly differentiated status intact during the intervening epochs. It also appears that the nearest relatives, and doubtless the lineal descendants of the Laramie and Tertiary fresh-water and land mollusca are found living in the fluvatile waters and drainage areas of the Mexican gulf and Arctic ocean, and not upon the Pacific slope. Some exceedingly interesting zoölogical questions are thus suggested.

No investigation of living forms has a more direct bearing

upon invertebrate palæontology than that of the Brachiopoda. For this reason mention should be made here of a memoir by Prof. W. K. Brooks, on the "Development of *Lingula* and the systematic position of the Brachiopods," published in Scientific Results for 1878, Chesapeake Zoölogical Laboratory, Johns Hopkins University, Baltimore, 1879. Prof. Brooks opposes the views so long and ably advocated by Prof. Morse, that the Brachiopoda are specialized worms, and presents his reasons for regarding them as more nearly related to the Polyzoans.

The foregoing notes, so far as is known, embrace all the publications that come within the scope of this article. There are, doubtless, other works in progress whose authors are waiting suitable opportunity to pursue their investigations. Prof. A. R. Grote has some uncompleted and unpublished notes on a new form of the remarkable crustacean genus *Ensarcus* Grote and Pitt, in the Waterlime group of Western New York. Prof. Verrill has also in hand the few fossils that were dredged from the submerged Tertiary beds off the north-eastern coast, but nothing has been published concerning the fauna of this Tertiary Atlantis since his article of last year in the *American Journal of Science and Arts.*

It has often been a subject of remark during the past few years that invertebrate palæontology was receiving comparatively little attention in the United States, but the foregoing makes a very satisfactory showing for the past year. The excellent character also of much of the work that is being done by the younger palæontologists promises well for the future.

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A REVIEW OF THE MODERN DOCTRINE OF EVOLUTION.—Concluded.[1]

BY E. D. COPE.

III. Metaphysics of Evolution.

I ENTER here upon a wide field, over which I can only skim on an occasion like the present. The subject has been already introduced by reference to consciousness as modifying

[1] A lecture delivered before the California Academy of Science, Oct. 27, 1879.

movement; of course then if movement modify structure, the latter is influenced by consciousness. The word consciousness was then, and is now, used in its simplest sense, viz: as synonymous with physical sensibility. Its lowest and most usual exhibition is the sense of touch; the special senses, taste, sight, etc., are higher forms, while thoughts and desires are organized products of the same raw material. Consciousness cannot be denied to many of the inferior animals; indeed, if we grant it to any, we must admit that it is displayed at times by even the lowest *Protozoön*. That these humble creatures should possess it, is apparently quite as probable as that the very similar bioplasts of the brain of man should be its seat.

Consciousness alone is not a sufficient basis for the development of mind. For this, one more element is necessary, and that is, *memory*. Impressions made by the environment are registered, and soon cease to be present in consciousness. Under the influence of association the impressions return to consciousness. Associations are those of place, of the order of time, and of similarity or difference in various qualities, as size, color or any other physical features. Experiences of these qualities are to all conscious beings either painful, indifferent or pleasurable. When association requires, events, objects or characteristics, are returned to consciousness in the order in which they cohere most firmly in the mind, which may or may not be that in which they entered it. The liking for or dislike to the object, are equivalent to an attraction to or repulsion from it. Thus experience is begotten: as its material increases, new combinations are formed, new relations observed, and in the highest types of mind, laws are discovered. No one can deny memory to animals; it is the medium of their education by man, and has been as well the means of their education by nature. Impressions cause a rearrangement of certain elements of structure which give the form to consciousness when it arises again. It is also probable that these arrangements are not the same as those which represent classifications and conclusions, but that nevertheless the arrangement or organization of these is determined by the simpler arrangements caused by perceptive stimuli. Experience produces these combinations in the bioplastic aggregations of all animals, be they in the form of ganglia, brains, or less specialized forms. Nowhere in the human organism are the effects of effort and use so strikingly witnessed as

in the increase of brain power; and familiarity with the education of the lower animals shows that this is the case with them also, though in a lesser degree than in man.

If, then, we grant the propositions, first, that effort and use modify structure; and second, that effort and use are determined by mind in direct ratio to its development, we are led to the conclusion that evolution is an outgrowth of mind, and that mind is the parent of the forms of living nature. This is, however, to reverse a very usual evolutionary hypothesis, viz: that mind is the product and highest development of the universe of matter and force. The contradiction is, however, not so absolute as at first appears. By mind, as the author of the organic world, I mean only the two elements, consciousness and memory. But it is the view of some thinkers that consciousness is a product; that it is not only a correlative of force, but a kind of force. To the latter theory I cannot subscribe; when it becomes possible to metamorphose music into potatoes, mathematics into mountains, and natural history into brown paper, then we can identify consciousness with force. The nature of consciousness is such as to distinguish it from all other thinkable things, and it must be ranged with matter and force as the third element of the universe.

It is true that unconsciousness does not imply absence of life as generally understood. A majority of the processes of life are performed unconsciously by living creatures; mind itself being no exception to this rule. There is another class of acts whose performance produces sensation, but consciousness is not concerned in them as an immediate cause. Therefore, it is a common endeavor to associate reflex and unconscious acts with the molecular movements of inorganic and non-living substances. But the one great difficulty in making this identification has never been surmounted. This is the different nature of the movements in the two cases. In non-living matter they are simply polar, nothing more. In living beings they display design. Perhaps I use the word "design" in a new sense, but the expression is nevertheless appropriate. What I mean is, that the movements of living things have direct reference to consciousness, to the satisfaction of pleasures, and to the avoidance of pains. The *molecular* movements within animals of the simplest class are the digestion of food and the elaboration of the materials of repro-

duction. The *molar* movements of the simplest animals are to enable them to escape the pains of hunger and celibacy. Moreover there is reason why the movements of living beings display design. We all know the nature of habits; how they are performed unconsciously, and as automatically as digestion itself. But did any one ever know of a habit in an animal, whose origin he could trace, which has been formed in unconsciousness? According to our knowledge, habits are always the result of stimuli which are consciously felt, and which cause by repetition or through reminiscence a repetition of the resulting movement. After a sufficient number of repetitions such an act becomes a habit, *i.e.*, is performed automatically, or without the intervention of effort, and frequently without consciousness. It thus becomes a part of the character of the individual or species. This common phenomenon is explained by the hypothesis, that an organization of the centers controlling action is caused by the efforts of the animal under the stimulus, and that finally a machine is constructed which determines the nature of the force expended, without further mental exertion of the individual. Such a process is education, and the result is an addition to the stock of faculties already on hand. Thus is explained the vast number of automatic and unconscious activities displayed by animals; to the same source, I believe, the common reflex acts may be traced; it even appears to me probable that the organic functions in general have had the same origin.[1] While these latter have mostly long since passed beyond the control of the mind, portions of the urogenital functions still linger within the confines of its jurisdiction. Thus have consciousness and mind endowed living nature with useful functions; and this, which may be called the *Theory of Endowment*, accounts for the element of design which is so puzzling when seen in unconscious and reflex acts.

As it has been maintained above, that structure is the effect of the control over matter exercised by mind, it is evident that the evolution of mind must be directly followed by corresponding development of organism. The science of palæontology substantiates this theory in a wonderful manner. But the animal mind being generally occupied with simple functions, its expressions in structure are usually nothing more than the progressive creation of improved instruments for obtaining food, resisting

[1] Consciousness in Evolution. *Penn Monthly*, 1875.

climate, escaping enemies, and reproducing their kind. The struggles of animals have been on this platform, and mind has only been necessary to aid in accomplishing the ends above mentioned. Wonderfully effective machines for grinding, cutting, seizing and digging; for running, swimming and flying have been produced. The development of mind proper must appear in the size and structure of the brain; and though the history of the latter in past ages must always remain, in large part, hidden from us, it is known that in the former respect there has been great progress made in various lines of animals. Now the line which has carried brain to its present development in man, the *Quadrumana*, has been deficient in special mechanical excellencies of the kind enumerated above. Perhaps primitive inferiority in these many respects has kept the *Quadrumana* under greater mental tension, and compelled them to exercise caution in their acts and give that opportunity to thought which was less demanded in the case of other animals. Furthermore, if they are less specialized in their mechanism than most other *Mammalia*, they are less restricted by it to peculiar modes of life. They are more versatile, and more capable of the adoption of new habits as a consequence. And here we have a glimpse of a most important principle in evolution, which is the keynote to its method; this is what I have called *The Doctrine of the Unspecialized.*

Palæontology shows that the succession of living types has not been in a single straight line. It has been in many divergent lines, and a large number of them have not continued to the present time. The history of life has been well compared to a tree with divergent branches, many of which do not reach the elevation of the summit. Furthermore, in the many cases in which we can trace the lower lines to the present period, it is evident that in their present condition they could not have given rise to the higher forms. Each line, in fact, has developed to an extreme of specialization of structure, which it would seem is incapable of modification in any direction very divergent from that which it has already taken. Much less have such specialized types been able to survive the environment for which they were designed; with important changes in that respect they have perished. A few examples will serve to illustrate my meaning. The direction of development has been from fishes, through *Batrachia* and reptiles, to birds and mammals. But we cannot

derive any living type from the osseous fishes of the present or past ages *(Hyopomata):* to find the origin of *Batrachia*, we must pass below these to more generalized and older forms, the *Dipnoi*, a class whose position in the system was for years a controverted point. We cannot obtain *Mammalia* from any of the existing types of reptiles, but we must go back to the Permian period, and trace their outlines in the *Theromorpha* of that day. In spite of the prophetic resemblance of these remarkable animals, they are inferior to later Reptilia in the structure of their vertebral column, and display resemblance to some of their immature stages, as well as to those of the *Mammalia*. Among mammals we cannot derive monkeys from *Carnivora* or *Ungulata*, nor the latter from each other, but can only trace their close approximation in the Bunotherian types of the Lower Eocene. So with the great divisions of *Ungulata; Proboscidians*, *Hyrax*, and the even and odd-toed orders must all be traced to the unspecialized *Amblypoda*, with small brains and five-toed plantigrade feet, as their ancestors.[1] It is easy to perceive that the generalization and plasticity of all these forms has furnished the ground of their ancestral relation.

We are now in a position to comprehend more clearly the general nature of evolution. The doctrine of the unspecialized teaches that the perfection produced by each successive age has not been the source or parent of future perfection. The types which have displayed the most specialized mechanism have either passed away, or, undergoing no change, have witnessed the progress and ultimate supremacy of those who were once their inferiors. This is largely true of animals which have attained great bulk. Like those with perfected weapons, they have ever been superior to the attacks of other animals in their day, and doubtless led, so long as food abounded, lives of luxurious indolence. With change or diminution of food, such huge beasts would be the first to succumb, and it is a fact that no type of land animals has maintained great size through many geologic changes. It is true that all of the lines of ancestry of the existing higher *Mammalia*, as the subdivisions of the *Carnivora*, *Ungulata* and *Quadrumana*, which we know in detail, commenced with types of small size and correspondingly little muscular power.

Some important conclusions may be derived from what has

[1] See the origin of types of *Mammalia educabilia*, Journal Academy, Philadelphia, 1874. This view was subsequently expressed by Huxley.

preceded. It seems that evolution has witnessed a continual running down of types to their great specialization or extinction. That many types have arisen in weak and small beginnings, but that the conflict with more powerful forms has developed some qualities in which they sooner or later excelled, and which formed the basis of their future superiority and persistence. That while this has probably been the true cause of the origin of the many admirable mechanical adaptations displayed by animals, it is preeminently true of the development of mind. That the reason why progress has reached its limit in the lines of greatest specialization, has probably been the removal of the occasion of its original cause, *i. e.*, active exercise in the struggle for existence. This explanation is suggested by the remarkable degradation which is witnessed in animals whose mode of life relieves them from the necessity of working for a livelihood, *e. g.*, the parasites and sessile animals whose young are free. Some of these creatures, on assuming their parasitic life, lose the semblance of even the order to which their young belong. The primary stages of various plants move actively through the water like the lowest forms of animals, and their sessile adult condition must be looked upon as a degeneration. It is well known that the endeavor to relegate the lowest forms of life to the two kingdoms of animal and vegetable, has been generally abandoned. The great vegetable kingdom probably exhibits a life degraded from more animal-like beginnings. Animal irritability and mobility have been lost, and their own consciousness must be entirely eliminated from the question of the origin of the many later and specialized types of plants. But I venture here the hypothesis that the consciousness of plant-using animals, as insects, has played a most important part in modifying the structure of the organs of fructification in the vegetable kingdom. Certain it is that insects have been effective agents in the preservation of certain forms of plants. I would suggest whether the mutilations and strains they have for long periods inflicted on the flowering organs, may not, as in some similar cases in the animal kingdom, have *originated* peculiarities of structure.

Evolution of living types is then a succession of elevations of platforms on which succeeding ones have built. The history of one horizon of life is, that its own completion but prepares the way of a higher one, furnishing the latter with conditions of a

still further development. Thus the vegetable kingdom died, so to speak, that the animal kingdom might live; having descended from an animal stage to subserve the function of food for animals. The successive types of animals have first stimulated the development of the most susceptible to the conflict of the struggle for existence, and afterwards furnished them with food. Doubtless in the occupation of the world's fields, the easiest and nearest at hand have been first occupied, and successively those which were more difficult. The digging animals are generally those which first abandoned the open field to more courageous or stronger rivals; and they remain to this day generally of low type compared with others of their classes (*e. g.*, *Monotremata*, *Rodentia*, *Insectivora*). All occupations have been filled before that one which requires the greatest expenditure of energy, *i. e.*, mental activity. But all other modes of life have fallen short of this one in giving the supremacy over nature.

Automatism then represents a condition of "lapsed intelligence" and diminished life. The unconscious automatism of animals is a condition of still greater lapse. On the contrary, sensibility is the condition of development, and the susceptibility and impressibility which is the extreme reverse of automatism is the especial character of youth. Here the "doctrine of the unspecialized" finds justification again.

What the future has in store for us in the history of inorganic force and its results, we can not now foresee, but I call attention in this connection to the important part played by life in the distribution of minerals. It has long been known that the carbon of the earth's crust was once in a living state, and it is admitted that the limestone once circulated in the fluids of animals. We have recently been compelled to believe that siliceous rocks are composed of the consolidated shells of minute plants, which they have elaborated from the water of the ocean. Silver and gold are segregated and deposited by seaweeds. The principal rock material, whose relation to life has not been ascertained, is alumina. How far the processes which now characterize dead matter were once related to life is a problem for the future.

IV. The Morals of Evolution.

The doctrines of the struggle for existence and survival of the fit in human life, have a two-fold application. The relative pro-

portions in which these applications are made, will depend on the moral development of him who makes them. Moral density and intelluctual stupidity (often nearly allied) will see in these two laws only the struggle for material power, and the survival of the strongest. They will hardly urge in these days, as they would infallibly have done had they lived a few centuries ago, that the strongest means the hardest hitter, or the most successful assassin, but they will probably believe that this pre-eminent position belongs to the most wealthy. From a purely dynamical standpoint this position is correct, yet it might be a useful question for such advocates to consider why it is that physical oppression and assassination should be less successful avenues to power than they once were.

There are two reasons why man does not grant the first place in his esteem to physical force. The first principles of morals are acquired in the struggle for existence. The idea of *meum* and *tuum* was speedily developed so soon as men associated together; and the habit of justice has doubtless been formed by the insistence of every man on his own rights, and by the power of combinations of men to control those who may from superior strength or other cause seek to violate the rights of property. Thus law originated, and from the earliest history of the race to the present day it has educated the barbarous and semi-barbarous to civilization. It is then easy to perceive that man gives the highest place in his affections to the *most just;* but there is yet another reason why this should be the case.

The reproductive instinct in the lower animals has developed into social affections, and these form a part of the character of the higher animals and, in an especial degree, of man. The sentiments of sympathy and benevolence are probably outgrowths of the same. While the rational faculties are concerned in the *knowledge* of right, these sentiments are a source of the *love* of right. This disposition is trusted by men as leading to the *practice* of right, in cases where the power to enforce it is not immediately present. The struggle for existence then among men ranges all the way from a rivalry of physical force to a rivalry for the possession of human esteem and affection. The robber and assassin of the lowest human races are represented by the slanderer and defamer in the higher. The ultimate prosperity of the just, asserted and foretold by prophets and poets, is but a forecast of the doctrine of the survival of the fittest. The unjust are sooner

or later eliminated by men from their society, either by death, seclusion or ostracism.

But the organized moral qualities cannot normally transcend in power, as motives of human action, those which secure his physical preservation. Lines of men in whom the sympathetic and generous qualities predominate over the self-preservative, must inevitably become extinct. Evolution can produce no higher development of the race (whatever may sometimes appear in individuals), than an equivalency in these two classes of forces. Beyond this the organization of the social faculities of the brain must always be repressed in the race, so that we can only expect to attain an equilibrium between them and the more purely selfish ones, as the very highest result of unassisted evolution. In this position the judgment is suspended between the opposing classes of motives; and it must ever remain doubtful in general as to whether resulting action will be just and right, or the reverse. I exclude from this question those generous acts which do not appear to the actor to conflict with self-interest. These may be termed *sympathetic* acts, and are quite distinct from the altruistic.[1] The sympathetic actions are seen at times in most animals. The altruistic acts, on the other hand, are those that express what is usually called "moral principle." Such acts may often coincide with the interest of the actor, but so long as they do not appear to him to do so, they are altruistic. It is part of the doctrine of evolution, that habits will ultimately disappear on the removal of their stimulating cause. The moral nature originated, and has been maintained, through the pressure of the fear of consequences. The removal of this pressure, through the acquisition of power, would then ultimately result in the diminution or loss of the moral nature, through disuse. The abuses of power are well known. This appears to be all that evolution can do for us in the production of the moral nature. So it would appear that no organized faculty of *self-sufficient altruistic justice* can be derived by the process of mental evolution. The result is rather a continued struggle between justice and injustice. It is, then, evident that any power which shall cause the permanent predominance of the just over the selfish faculties must be derived from without.

After we omit from customary religion, cosmogony, which belongs to science, and theogony, which belongs to the imagination, we have left an art which has for its object the development

[1] On the Origin of the Will. *Penn Monthly*, 1877.

and sustentation of good works or morals among men. If the teachers and professors of this art produce the results in this direction at which they aim, their great utility must be conceded by all. Their method has the advantage over that of the law, in being of the character of inducements supplied before action, instead of pains and penalties inflicted after action. They strive to *originate* good conduct, rather than to punish bad conduct. They are working on the side of the *originative* force in development, rather than the destructive; the "*origin of the fittest*," rather than the "*survival of the fittest*." Whether man possesses the spontaneous power called "free will" or not, the work of supplying inducements for good conduct is most useful to society. But religion, as generally understood, pre-supposes free will; and the definition of the word responsibility implies its existence. The question as to the presence of such a faculty is an interesting one, and will now be briefly considered.

The well-known doctrine of necessity leaves no place for free will. All acts are the consequences of motives, and are the outcome of a balancing of interests. The heaviest side of the account determines action. Our physical necessities supply the motives for most of our activities; our pursuit of food and clothing is of necessity, and no condition is free from it. Evolution supports and explains this doctrine, as can readily be perceived. It derives our instincts from an ancestry whose daily occupation has been their gratification. But it has been shown above that this development does not supply the motives of an independent morality.[1]

The direction of action under stimulus is determined by intelligence, which is, as has been above maintained, the product of experience. Intelligence is organized or classified knowledge, and directs the activities set on foot by the likes and dislikes, that is, the affections. *When there is knowledge, there is no necessity for spontaneous action or free will*, since action is determined by the organization of the mind. Even if the mind is conscious of insufficient knowledge, an inducement to seek knowledge is supplied, and according to the result of investigation will be the direction of knowledge.

But we are here brought to face the case where knowledge cannot be or is not obtained. This is the condition of the two

[1] On the Origin of the Will. *Penn Monthly*, 1877.

questions of the practice of morals, and the nature of the future life. The evolution of mind consists of a continual advance from the known into the unknown, and a transfer of the unknown to the known. So long as there is any inducement to progress of this kind, and nature responds to inquiry, development will go on. Although it is true that it is only among men, and but few men at that, that the pursuit of knowledge is an occupation; most men add to their stock incidentally as they pursue other avocations. The knowledge of right and the inducements to its practice are learned in their every-day intercourse, so far as it can be acquired. But knowledge in these directions soon attains its limit, and accordingly, development dependent on knowledge must cease. If any further progress in practical morals is to be made, some new force must intervene at this point.

Here is the opportunity for the appearance of will or spontaneity; here it is at least needed. I am willing to believe that it may appear at this point, and that so long as we have to face the unknown in moral progress, so long it will remain. As a force it must be equivalent of other forces, but as a form of consciousness it is a new element of mind. As represented in new molecular organization, it may always continue, even after much of the unknown may have been conquered, and a stationary period may have ensued. Such an accession to character would be a fitting crown of evolution, and a justification of this labor of the ages. If a true factor in human development, it might be compared, in the creation of character, to the apical bud of a growing tree. As the part preëminently living, it leads the growth of the trunk and branches. They all follow of necessity the path it has marked out. Under its lead they are successively formed, become fixed, and finally decay.

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THE TONGUE OF THE HONEY BEE.

BY PROF. A. J. COOK.

THE bee is, and has long been, of great importance to the commercial world, and this, together with the fascination inseparable from its study, have led many of the ablest scientists to carefully investigate its structure and habits. Yet I know not if there exists to-day an accurate description of a bee's tongue, and the method by which the insect procures its food.

The literature of the subject abounds in confusion and inac-

curacy. The most learned scientists, those usually the most careful and accurate, like Reaumur, Newport and Carpenter, give voice to palpable errors. Even the last edition of the Encyclopædia Britannica gives further life to these old erroneous views. Let us give brief attention to some of these descriptions.

Hogg says the bee's tongue is cylindrical; Kirby, Spence and Neighbour state that it is flat; Reaumur and Chambers that it is between the two. Reaumur, Newport, Kirby, Spence, Carpenter, Shuckard, Bevan and Hunter all state that the tongue is solid, and that the honey is sopped up, or taken through a tube, formed by the close approximation of the maxillæ, labium, and labial palpi. Newport speaks of a hairy sheath along the under side of the basal two-thirds of the organ. Neighbour says there is a gutter throughout the entire length of the tongue, while Swammerdam, Lamarck, Burmeister, Wildman and Munn claim that the organ is tubular. Newport and Carpenter assert that the bee's tongue is muscular, which is denied by Cuvier, Reaumur and Chambers.

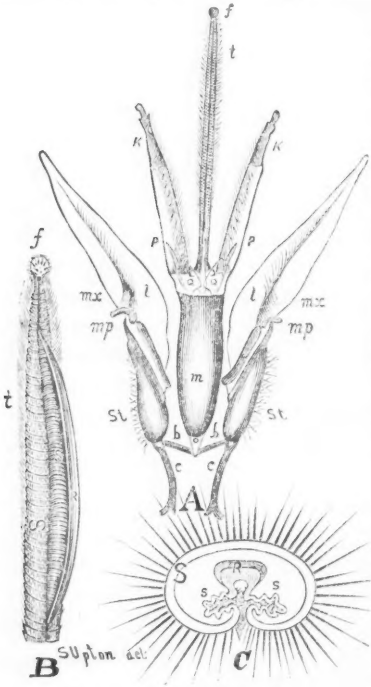

FIG. 1.—Tongues of the Bee.

That bees lap the nectar is affirmed by Reaumur, Newport, Kirby and Spence, Savigny, Carpenter, Bevan and Hunter; while Swammerdam, Wildman, Lamarck, Burmeister, Munn and Neighbour claim that the bees take liquids by suction.

Amid these conflicting views let us see if we may find the truth. To do this we must examine closely the structure of the organ, and also watch the insect as it is taking its fill of honey or some other liquid.

In the April number of the Journal of the Cincinnati Society

of Natural History, for 1878, Mr. V. T. Chambers, an able entomologist of Covington, Kentucky, published a very admirable paper upon this subject. In the American Quarterly Microscopical Journal for 1879, p. 287, the subject was again presented in a beautifully illustrated article by Mr. J. D. Hyatt, President of the New York Microscopical Society. I learn that Wolff has published a fully illustrated memoir on the anatomy of the honey-bee which, I regret to say, I have not seen. From Messrs. Chambers and Hyatt's papers, and my own researches and observations, I am able to present the following facts:

The mouth-parts of the honey-bee brought into requisition when the insect takes a liquid into its pharynx, are the maxillæ and the labium.

The maxillæ or second jaws (see *m x* in Fig 1, A) are situated each side of the labium. They are hinged to the head by the strong cardos (see *c c* in Fig. A) which are chitinous rods. Extending forward from the cardo is the more flattened stipes (see *st*, *st* in Fig. A) which is also mainly chitinous. From the stipes projects the triangular, deeply grooved lacinia (see *l*, *l* in Fig. 1, A). This is more membranous, but it is strengthened by a ridge of chitine which extends to the apex. At the base the very rudimentary maxillary palpi (see *mp*, *mp* in Fig. 1, A) are visible, while scattering hairs project from the inner margins. When the maxillæ are brought close together a tube is formed, which is continued by aid of a colorless membrane to the opening into the pharynx. This opening is beneath the labium and between the mandibles. The colorless membrane is continuous with the epipharynx. The muscles which move the maxillæ are attached mainly to the cardo and stipes.

The labium or lower lip of the worker honey-bee is from twenty-three to twenty-seven hundredths of an inch long. It consists of a central portion, and two pairs of appendages, the paraglossæ (see *p*, *p* in Fig. 1, A) and the labial palpi (see *k*, *k* in Fig. 1, A). The central portion is divided into a basal two-sevenths, or mentum (see *m* in Fig. A) and the terminal five-sevenths or ligula (see *t* in Fig. 1, A and B). The mentum is about seven-hundredths of an inch long. It is hinged to the sub-mentum (see *o* in Fig. 1, A) which in turn is hinged to the maxillæ by two chitinous rods (see *b*, *b* in Fig. 1, A). These rods permit free motion,

and to them are attached muscles, which in part affect the movement of the labium. The mentum is a flattened cylinder, the floor and sides of which are thick and opaque, because of the abundance of chitine contained in their structure. While lining this chitinous gutter and completing the tube is a thin colorless membrane, which is but the anterior prolongation of the pharynx. There also abundant muscles within the mentum which extend even for a short distance along the sides of the base of the tongue. These not only affect the motion of the whole labium, but also protrude and retract the ligula or tongue.

The ligula or tongue (Fig. 1, A and B, *t*) extends from the anterior extremity of the mentum. It consists of a sheath (Fig. B, *s*) which from the many rows of yellowish hairs appears annulated. When not distended, the sheath, as seen in cross-section (Fig. 1, C), is kidney-shaped. It has a slit (Fig. 1, C, *h*) along the under surface, from the base very near the end. In some specimens the slit seems to reach quite the end. Within the sheath is a small colored, triangular rod (Fig. 1, C, R) darker than the sheath, which except for a slit (Fig. 1, C, *h*) on its under surface, would form a tube Fig. 1, C, R); in fact the sides of the rod along the slit can be brought in such close contact as virtually to form a tube. Fine hairs project from the walls either side the slit (Fig. 1, C, *h*) into the tube, which doubtless aid in making the tube more perfect. Along the back of the rod is a conspicuous layer which Mr. Hyatt asserts is muscular. If this be so we can readily see how its action would spread the walls and open the slit. The rod projects beyond the sheath, as an imperfect funnel, the "button" of Reaumur (Fig. 1, A. and B, *f*). The wanting section of the funnel harmonizes with the slit in the rod. Near the end, the rod seems firmly attached to the sheath. Any attempt to draw the rod from this position is quite certain to rupture the sheath. The rod when extended projects from sixteen to eighteen-hundredths of an inch beyond the mentum. At the base the rod is colorless, and its tube connects above with the membranous sack next to be described, and through this with the tube of the mentum and with the pharynx.

Attached to the edges of the sheath, next to the slit, and possibly, as Mr. Chambers thinks, entirely lining the latter, and also to the corresponding edges of the tubular rod is a thin membrane (Fig. 1, C, *s*). Mr. Chambers thinks this passes over the slit in the rod, making the tube of the latter complete. I have reasons to

think he is mistaken, as will appear in the sequel. When not distended this membrane lies in folds (Fig. 1, C, *s*); but when distended it with the rod pushes out of the sheath, so as to form with the latter a large tubular sack (Fig. B S, *s*), with the tubular rod (Fig. C, R) along the surface opposite the sheath. At the base this sack has a chitinous support (Fig. A, Q Q), and connects through the tube of the mentum with the pharynx, and receives the tube of the rod. It extends nearly if not quite to the end of the sheath, certainly as far as the slit in the latter extends, and is, anteriorly, imperforate.

The labial palpi (Fig. 1, A, *k*, *k*) like the maxillæ, are deeply grooved, and when brought close together form a tube which also has a membranous connection with the mouth opening into the pharynx.

The paraglossæ are short, leaf-like organs (Fig. 1, A, *p*, *p*) with a hollow membranous base, which also connects with the tube of the mentum and the sack of the ligula.

When not in use the ligula, with the labial palpi and maxillæ, all double back under the head, and the tongue is so retracted that it extends no further than the labial palpi. This shortening of the ligula seems to be effected by drawing the more membranous and less hairy base into the mentum.

How do bees take liquids into their stomachs? This question, as we have seen, has received various answers. Some have thought that the nectar was drawn through a tube formed by the approximation of the ligula, the palpi and the maxillæ. Others that suction was the force and the tongue the tube. Still others have believed that the nectar was lapped up by the bees. I hope to be able to show you that all are right.

Look at the bee through a good lens (I have used Toll's one-half inch) while sipping honey containing grains of solid matter, and the fine particles will often be seen to ascend through the tube formed by bringing the maxillæ together. We have already seen how this liquid passes to the mouth and through this into the pharynx. Or we can color some rather thin honey or syrup by aniline (I have found deep red to be the best), and while the bee is sipping this colored liquid, which it does as eagerly as though the poisonous aliline were not present, cut off its head, which, with a pair of dissecting scissors is done in an instant. Examination plainly shows the track along the channeled maxillæ

and palpi, even to the mouth, which clearly reveals the path of the liquid. These conduits are much the larger approach to the pharynx; thus we see why bees take honey so fast when they can get freely at a large quantity, and why a few days of good basswood harvest are so fruitful.

Bees as surely take honey through the triangular rod which is enclosed within the sheath. I have proved this in several ways as follows:

I have placed honey in fine glass tubes and behind fine wire gauze, so that the bees could just reach it with the funnel at the end of the rod. So long as they could reach it with the funnel so long would it disappear. I have held the bee in my hand, by grasping the wings, while observing it with a good lens. I would gradually withdraw it from the drop of honey, which it would sip so long as the drop was within reach of the funnel. I have in such cases seen the red axis when the bee was sipping colored syrup. Subsequent examination by dissection revealed the red liquid still in the tube of the rod, clearly showing its course in passing to the pharynx. If we place the tongue with a drop of water on a glass slide and cover with a thin glass, and then look at it through the compound microscope, with a magnifying power of eighty diameters, we can readily see the liquid pass back and forth in the tube as we press with a pencil on the thin glass cover. As Mr. Chambers states, this tube at the base of the funnel is only one five-hundredth of an inch in diameter. We now understand why bees are so long in loading their stomachs when gathering from small tubular flowers, as then this minute tube is the only avenue by which the bee secures the nectar. We can also well understand why they gather so much faster from some flowers than from others. In the one case they secure the liquid sweet through both the channels above described, in the other, when the honey is scarce or deep down in small tubular flowers, they can only use this microscopic tube.

We also note the admirable construction of the tongue, which permits it to probe these tiny flowers, and also see the advantage of even a little additional length in this important and wonderful organ.

I also believe that bees lap up the honey. If we spread a thin layer of honey on a glass, and permit the bees to visit it, we shall see the bees wipe it up with their ligulæ. Fine drops dis-

appear even though the funnel does not touch them. From this observation, as well as the structure of the organ—if I am right in believing that the slit in the rod opens on the surface—we can but conclude that the slit in the rod, no less than the funnel, may be the door whereby liquids pass to the tube. If Mr. Hyatt is right in thinking that the dorsal band of the rod is muscular, we can readily see from its position and the form of the rod, how the slit might be opened. If the liquid is very thick the bees are seen frequently to retract the ligula and then extend it, as if to clear the organ by scraping it between the maxillæ and palpi.

While sipping honey the bee performs a kind of respiratory movement with the abdomen. This shows that the force of suction comes partly, if not wholly from the stomach, which organ is situated in the abdominal cavity. The tongue is also retracted and extended rythmically while the bee is sipping. The tip passes alternately back and forth from its greatest distance from the mentum to the end of the palpi. This movement may be something analogous to swallowing.

I am not certain as to the function of the membranous sack. I have found that if I killed a bee by compressing its thorax, very soon after it commenced to sip the colored liquid, that the latter was always in the stomach but not in the sack. If I waited longer I found the sack also partially filled. This leads me to conclude that it acts as a storehouse, enabling the bee to carry a load beyond the capacity of its stomach. It also appears glandular, when distended, so possibly it secretes an animal juice or ferment which aids in changing cane sugar into glucose or grape sugar; for we find upon analysis that pure cane sugar after passing through the stomach of the bee has partially undergone this transformation.

After the bees have sipped the colored liquid, I find invariably that the tip of the tongue—the small portion where the slit in the sheath seems obscure, and where the rod seems more firmly attached to the sheath, is highly colored, as though full of liquid. Possibly the sac does not extend into this portion, and the tube may be larger in this part. By a little pressure the liquid is made to pass out of this portion of the tube, either through the funnel or slit, perhaps both.

I have measured hundreds of tongues, under the microscope, with the camera lucida, and have been much interested to observe

the wondrous uniformity in length where the bees were from the same colony or from the same apiary, especially if close breeding had been practiced. Tongue after tongue would show a variation of less than .025 of an inch. I have found the length of the American black bee's tongue to average about .24 of an inch in length, from the base of the mentum to the tip of the ligula. American-bred Italian bees I have found, when measured by the same scale, to have tongues .02 of an inch longer. Some bees, said to be Cyprians, but closely resembling our black bees, except that the down on the thorax was a little more yellow, I have found to possess tongues a little shorter than those of our American Italians, though the average is but very little less. I have examined bees' tongues from workers reared from two different imported Italian queens, and found that in both cases they exceeded in length those of our American-bred bees, though the difference is very slight.

In 1878 I measured the tongues of some bees sent me for Cyprians. The bees were very yellow and beautiful. I found them to possess the longest tongues I have ever met, but there was very great variation. I had but few bees and sent for more, which never came. I had arranged the present season for bees of the various European races, and had been promised specimens, but greatly to my regret and disappointment, the bees have failed to come, so I have to make this but a partial report.

That the added length is of practical importance I have proved as follows: Honey in a vessel covered with fine gauze was placed before Italians till they ceased to eat because the honey was beyond reach. The vessel was then placed before black bees, which failed to reach the fluid. The vessel was then filled and given first to the black bees, which worked till the liquid was inaccessible, when it was placed before Italians. These would invariably commence to sip the honey. Again, a box one-half inch deep, without top or bottom, was covered with fine gauze having fifteen meshes to the inch. A glass was then placed in the box so inclined that while one end rested against the gauze the other was one-half inch from it. The glass was thinly spread with honey on the side next the gauze. This was placed in a hive of Italians, when the glass was cleaned of honey for a distance of twenty-four meshes from the edge where the glass rested on the gauze. The black bees could only reach and only

cleaned for nineteen meshes. Many trials gave the same result. This then shows why Italians can gather, and often do collect from flowers which fail utterly to attract the black bees. The nectar is beyond their reach.

It would seem from the above that American-bred bees have shorter tongues than those direct from Italy. It seems very probable that "natural selection," the very law which raised the Italians to their position of superiority, also gave to them their longer tongues. Shut up in their mountain home, a mere isolated basin, where competition must have been very excessive, nature took advantage of every favorable variation and developed those striking excellences peculiar to the Italian. During these ages there was no kindly bee-master possessed of the intelligence sufficient to nurse the weaklings, nor any "Dollar Queen business" to stimulate indiscriminate breeding, and the weak died victims to starvation. And so we are indebted to the stern, inexorable law of nature for the incomparable breeding which wrought out such admirable results in far-famed Liguria. Unquestionably the crowded apiaries of Austria and Germany have heightened the "struggle for life," and had a similar tendency to develop superior excellence in the European black bees. It is more than probable that the German bees of crowded Europe have longer tongues and are generally superior to the same in America, where they have long been favored with broad floral areas and comparative absence of competition. I should expect that this very law might have developed varieties of the black race which are superior to others of the same race. It is more than possible that "survival of the fittest" explains the origin of the superior varieties which are said to exist in various provinces of Europe. For the same reason we should surely expect superior excellence in the Cyprian bees. Crowded as they have been for long years or ages in their small island home, the principle of "survival of the fittest" must have been working powerfully to weed out the inferior and to preserve and make stronger the superior. And so the great poet has well said: "Sweet are the uses of adversity."

From the above considerations it seems obvious, that would we perpetuate the excellencies given us by the skillful breeding of nature, though we may not destroy all the feeble, as nature has done, we must assuredly study and observe so closely, that we shall know of a surety which are our very superior queens, and be even

more careful to breed from no other. Whether care or carelessness will be most promoted by our present system I leave for you to say. But I do wish that we might have at least a few breeders with time, means, caution, skill and patience, who would work with earnest zeal to not only keep all the excellence we now have, but to augment this excellence, as I am sure it may be augmented.

But if our cheap queen system is to continue, then, surely, we may well stimulate frequent importations from Italy and Cyprus, and thus hope to compensate in part for what will be lost by hasty, careless and indiscriminate breeding.—*American Bee Journal.*

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RECENT LITERATURE.

BREHM'S ANIMAL LIFE.[1]—This volume treats of the fishes, and is smaller than the others of the series. Beginning with the Dipnoans, the larger part of the space is devoted to the bony fishes, closing with the Selachians, the Cyclostomata and Amphioxus. The style is highly popular, as few anatomical details are given, but the text is taken up with very general accounts of the natural history of the more interesting species, with popularized illustrations in wood and full-page copper plates. In the preliminary glance at the life of fishes in general, their structure and physiology, habitats, distribution, habits and mode of development are, as well as fisheries and fish culture, briefly discussed. The Dipnoans are too briefly disposed of, only the Protopterus or lung-fish of Africa being figured and described; nothing is said of the Australian lung-fish (Ceratodus), nor of the relations of the Dipnoans to their mesozoic ancestors. The opportunity of working up a fresh and attractive account of the most interesting group of fishes in existence is not taken, and this part is nearly twenty years behind the times. The bony fishes are finely illustrated, the drawings of the eel, lump-fish and goose-fish, for example, being particularly good. We should have liked to have learned more of the singular breeding habits of the sea-horse; as to the garpike the reader is left in ignorance of its breeding habits so well known in this country, and the ganoids are too briefly treated; Ammocœtes is still regarded as an adult fish, though well known to be simply a young lamprey. On the whole, however, the volume is interesting and attractive, and so rich in good illustrations as to be of considerable value to the naturalist.

[1] *Brehm's Thierleben.* Achte Band. Die Fische. Von Dr. A. E. BREHM. 114 cuts and 11 plates. Leipzig, 1879. 8°, pp. 426. For sale by B. Westermann & Co., New York.

GRENACHER'S RESEARCHES ON THE EYES OF ARTHROPODS.[1]—This is the most elaborate and detailed work on the eyes of insects and crustacea which has yet appeared. For the first time we have very full information given us as to the nature of the simple eyes (ocelli or stemmata) of larval insects and of Arachnida, and we are here taught that they are much more complicated than was before suspected; so that they are not exactly a simple, elementary eye, as it were, a primitive form of eye, but, as the author claims, the simple and compound eyes stand in the relation of sisters, rather than of child and parent.

A long chapter on the physiology of the compound eyes lends additional value to the anatomical portion. The author concludes that perception in the compound eye of Arthropods is effected in accordance with the theory first proposed by Müller, and that this applies to the compound eye of the horse-shoe crab (Limulus) although morphologically the eye of this animal is totally unlike that of any insect or crustacean. Grenacher does not describe the eyes of the myriopods, though he observes that the compound eyes of Cermatia are entirely unlike those of the spiders or insects, and that they seem to show some analogy to those of Limulus. The illustrations are abundant and simply exquisite, and worthy of the text.

DALL'S METEOROLOGY OF THE PACIFIC COAST PILOT.[2]—This is the results of several years' examination by Mr. Dall into the meteorological features of Alaska, together with the data collected from the publications of learned societies and from unpublished material in the archives of the U. S. Coast Survey, the Medical Department of the U. S. Army, and the U. S. Signal Service, as well as numerous contributions from private sources. The whole appears to be a most useful and accurate account of the climatic features of Alaska. While the attempt has been made to elucidate the general climate of this region, the local peculiarities relating especially to commerce, navigation and agriculture have been made sufficiently prominent. To geographers and Arctic explorers this volume will especially commend itself, as well as to students of the geographical distribution of plants and animals. To the latter the charts will prove useful; that showing the distribution of plants and animals, and the following one (XXVIII) showing, with the summer sea-surface temperature, the limits of trees, are new and fresh contributions to our knowledge of the life of this and the neighboring subarctic regions.

[1] *Untersuchungen über das Sehorgan der Arthropoden, insbesondere der Spinnen, Insecten und Crustaceen.* Von H. GRENACHER. 11 lith. plates. Göttingen, 1879. 4°, pp. 188. 45 marks.

[2] *U. S. Coast and Geodetic Survey.* C. P. PATTERSON, Superintendent Pacific Coast Pilot, Coasts and Islands of Alaska. Second Series. *Meteorology.* By W. H. DALL, Acting Assistant U. S. Coast Survey. Washington, 1879. 4°, pp. 375. 28 charts and 12 plates.

This volume will admirably supplement the series of memoirs in course of publication on the marine zoölogy of Alaska by Mr. Dall, who has made very extensive collections on the coast of Alaska.

BARRANDE'S BRACHIOPODS OF BOHEMIA.[1]—This volume of extracts from the fifth of the magnificent series of the *Système Silurien du Centre de la Bohême*, is of very general interest to palæontological students, since it gives the results of the author's studies upon an interesting series of faunæ, where the succession is quite complete; and although the distinguished author is quite fully persuaded that his facts and inductions are opposed to the theory of descent, others who favor the theory find these profound works rich in facts and inferences which go to strengthen their own views; so anything that comes from the palæontological workshop at Prague—and least of all are they mere chips—is always welcomed.

It will be seen how useful to the general student of biology this book will prove when we enumerate the subjects here treated:

I. Variations observed among the Silurian Brachiopods of Bohemia.

II. Vertical distribution of the genera and species of Brachiopods in the Silurian basin of Bohemia.

III. Specific connections established by the Brachiopods between the Silurian faunæ of Bohemia and the Palæozoic faunæ of foreign countries.

HUXLEY ON THE CRAYFISH.[2]—Whether it is because we happen to be just now greatly interested in the crayfish and its belongings, or because this book is in itself very attractive, we confess ourselves very much pleased and interested in it. The method of teaching zoölogy now-a-days is to induce the student to learn all he can from the thorough, detailed study of one or several types, rather than to bewilder his brain with a ponderous classification of the entire animal kingdom and a large but thin mass of superficial pseudo-knowledge of it. He is now taught to become, *ab initio*, an original investigator, to discover new facts for himself, or at least to discover what are to him new facts, and thus enthusiasm and real interest in the subject are bred. Just now a class of college students are studying with us and drawing the structure of the lobster, and with most excellent results in the way of exciting their interest and curiosity; judging by the results this seems to us to be the very best way of teaching natural history. This book, which is a monograph of the crayfish from

[1] *Brachiopodes.* Etudes locales. Extraits du Système Silurien du Centre de la Bohême. Vol. v. Brachiopodes. 7 Planches. Par JOACHIM BARRANDE. Prague et Paris, 1879. 8°, pp. 356.

[2] The International Scientific Series. The Crayfish. An Introduction to the study of Zoölogy. By T. H. HUXLEY. With 82 illustrations. New York, D. Appleton & Co., 1880. 12°, pp. 371.

every point of view, will prove a great aid in such teaching. The story is told in a straightforward, honest way, and so truthfully that there is little or no room for fault-finding. We may not believe, with the author, that the eyes of the crayfish or any other Crustacean are homologous with the legs, but this does not impair our enjoyment of the story of the structure of the eye and how the crayfish sees, and how its mind, or what answers to a mind, operates. The illustrations are most excellent.

THOMAS' NOXIOUS INSECTS OF ILLINOIS.[1]—Instead of trying to cover the whole or even the larger part of the field, the author has wisely confined himself to working up one and a very important group of injurious insects, the plant lice. The group is treated of systematically, the genera and species described at sufficient length for determination, and their habits described as fully as possible, with remarks on their insect enemies and the best remedies against their attacks. With this report in hand any one in Illinois or adjoining States, whose crops or fruit trees or flowers are afflicted by these troublesome pests, can ascertain their affinities and names, and the best means of getting rid of them. A great deal of useful information is scattered through the report, which, barring some defects in its typographical appearance, the common fault of State reports, is well worthy of wide distribution and use by farmers and gardeners. A number of new species are described, and as this volume is the first attempt to treat monographically of this extensive family of insects, it is worthy of the attention of the entomologist as well as the layman.

RILEY ON THE COTTON WORM.[2]—This third Bulletin of the U. S. Entomological Commission gives the results of Prof. Riley's researches on the cotton worm (*Aletia argillacea*), which is so injurious to the cotton plant that the average annual loss is estimated at over $12,000,000. The author, after treating of the losses sustained from the attacks of this caterpillar, describes the egg and metamorphoses and habits of the insect in its different stages. Riley has discovered that, contrary to the usual impression, the worm hatches in April, and that the third generation is the most abundant, this having usually been regarded as the first, there being seven annual generations in the extreme Southern States. The relations of the soil, of the weather, to the development of the caterpillars are referred to; and the author states his belief that the moth hybernates in the southern portion of the

[1] *Eighth Report of the State Entomologist on the Noxious and Beneficial Insects of the State of Illinois.* Third Annual Report by CYRUS THOMAS, State Entomologist. Springfield, 1879. 8°, pp. 212.

[2] Department of the Interior. United States Entomological Commission, Bulletin No. 3. The Cotton Worm. Summary of its Natural History, with an account of its Enemies, and the best means of controlling it; being a report of progress of the work of the Commission. By CHARLES V. RILEY, M. A., Ph D. Washington, January 28, 1880. 8°, pp. 144, with numerous illustrations.

cotton belt, though most of the moths die off in the autumn. The insect parasites, twelve in number, which prey upon them are described, while a large part of the Bulletin is taken up with the various remedies employed, of which Paris green, London purple, these being preparations of arsenic, are strongly advocated, and a number of machines and contrivances for sprinkling and spraying dry and liquid poisons are figured and described. The work will be of great use to cotton planters; and to entomologists the entire subject and its skillful mode of treatment will render it of permanent value.

GILBERT'S GEOLOGY OF THE HENRY MOUNTAINS.[1]—The teacher as well as student of general geology in this country who would be at all informed as to the broader features of American geology and palæontology is compelled to resort to the magnificent series of reports of our geological surveys of the Western Territories. These, almost without exception, have been ably prepared, and in most respects certainly worthy of the time and money bestowed upon the work. From them have been and will be largely derived the materials for our text books. The present monograph, though not bulky, is a finished and elaborate study of an interesting group of mountains forming one of the western outlines of one of the flexures of the Rocky Mountain range, and rising suddenly from what has otherwise been a region of geological calm. This group of five elevations forms as many *laccolites*, as the author terms them. It is usual, he says, for igneous rocks to ascend to the surface of the earth and build up mountains or hills by successive eruptions. Such are volcanoes. Now, when the lava, instead of rising through all the beds of the earth's crust, stops at a lower horizon, and insinuates itself between two strata and opens for itself a chamber by lifting all the overlying strata, and here cools, forming a massive body of trap, a laccolite (*laccos*, cistern, and *lithos*, stone) is formed. This is the mode in which the Henry Mountains were formed, as well as numerous other isolated groups in the Plateau region. That many similar peaks, with the Elk mountains of Colorado, elaborately described by Messrs. Holmes and Peale, of Hayden's Survey of the Territories, were formed in an identical manner has been independently established by these geologists, as stated by our author.

Gilbert also makes the generalization that there are two types of igneous rock. "One type of rock is acidic, including porphyritic trachyte and eruptive granite, and its occurrence is, without exception, intrusive. The other type of rock is basic, including basic trachyte and basalt, and its occurrence is almost uniformly extrusive." It appears that each group of laccolites is composed

[1] Department of the Interior. U. S. Geographical and Geological Survey of the Rocky Mountain Region. Report on the Geology of the Henry Mountains. By G. K. GILBERT. Washington, 1877. (Received Nov. 10, 1879.) 4°, pp. 160. 5 plates and wood-cuts.

of many individuals, just as volcanoes are dotted over with miniature volcanets, so to speak, as may be seen on the flanks of Mt. Shasta. For example, "in the Uinkaret mountains, Major Powell has distinguished no less than one hundred and eighteen eruptive cones, and in the Henry mountains I have enumerated thirty-six individual laccolites. In one locality basic lava has one hundred and eighteen times risen to the surface by channels more or less distinct, instead of opening chambers for itself below. In the other locality porphyritic trachyte has thirty-six times built laccolites instead of rising to the surface." In answer to the question, why in some cases igneous rocks form volcanoes and in others laccolites, it is stated that "when lavas forced upward from lower lying reservoirs reach the zone in which there is the least hydrostatic resistance to their accumulation, they cease to rise. If this zone is at the top of the earth's crust they build volcanoes; if it is beneath, they build laccolites. Light lavas are more apt to produce volcanoes; heavy, laccolites. The porphyritic trachytes of the Plateau Province produced laccolites." The process of formation is thus summarized: "The station of the laccolite being decided, the first step in its formation is the intrusion along a parting of strata, of a thin sheet of lava, which spreads until it has an area adequate, on the principle of the hydrostatic press, to the deformation of the covering strata. The spreading sheet always extends itself in the direction of least resistance, and if the resistances are equal on all sides, takes a circular form. So soon as the lava can uparch the strata it does so, and the sheet becomes a laccolite." It then grows in size until the lava clogs by congelation in its conduit and the inflow stops, the irruption being completed. During the eruption and after it has ended there is an interchange of temperatures. The original laccolite thus growing by successive additions until its cooled mass, heavier and tougher than the surrounding rocks, proves a sufficient obstacle to intrusion. "The next eruption then avoids it, opens a new conduit, and builds a new laccolite at its side. By successive shiftings of the conduit a group of laccolites is formed, just as by the shifting of vents eruptive cones are grouped." Now the strata above are bent instead of broken, but though "quasi-plastic, it is none the less solid, and can be cracked open if the gap is instantaneously filled, the cracking and filling being one event. This happens in the immediate walls of the laccolite, and they are injected by dikes and sheets of the lava."

We must here remark that the impression left on the mind after having read this book, is that the discovery of this type of mountain structure is entirely due to Mr. Gilbert, although a careful reading shows that he recognized the fact that the Henry mountains are not the only examples of what he terms the "laccolite." Prof. Newberry, who examined the Sierra Abajo in 1859, was probably the first to recognize the peculiar structure,

but his examinations were rather cursory. This mountain, with others farther to the east, were carefully studied by Mr. W. H. Holmes, of the Hayden Survey, in 1875 and 1876, and his illustrations in the reports for those years show the same structure in the La Plata mountains, the Sierra Carrisso, and the Sierra El Late, in South-western Colorado and adjacent regions, with some points that do not appear in the Henry mountains, probably on account of the greater simplicity of the latter. Mr. Holmes' drawings appear to be nearer to nature, *i. e.*, less schematic. Scattered through Hayden's reports from 1873 to 1876 are many descriptions of this type of structure, and the term *Porphyritic-Trachyte* (p. 64 and 68) used by Mr. Gilbert to designate the group to which the rocks belong, was first used by Dr. A. C. Peale, of Hayden's corps, in 1874 (see his report for 1874 in Hayden's Annual Report), and afterwards he always used the term in designating the rocks.

Mr. Clarence King, in his report (Systematic Geology, 1878, p. 581), proposes the name *Trachytoid-porphyry* for the group, having recognized the resemblance of certain rocks occurring within the area of his explorations, to those of the Henry mountains. He also recognizes the peculiar petrographical position of the rocks, one extreme of which cannot be distinguished from granite, and the other of which is undoubtedly trachyte. This fact was also pointed out by Dr. Peale in 1874 and 1875 (see his reports to Dr. Hayden). The descriptions of the localities mentioned in Dr. Hayden's Annual Reports were brought together in an article (On a peculiar type of Eruptive Mountains in Colorado) in Bulletin No. 3, Vol. III, of the U. S. Geological Survey of the Territories, published May 15, 1877. Mr. Gilbert's volume is dated Washington, 1877, although it was not published until about four months ago.

Batrachological Papers.—Prof. Peters, of Berlin, has recently published an important paper in the Berlin Monatsberichte,[1] on the *Cæciliidæ*. He discovered two new generic forms in which the usual position of the orbit is covered over by the squamosal bone, thus enclosing the rudimental eye in the fundus of the tentacular canal. One of these, *Gymnopis*, is American; the other, *Herpele*, is African. Prof. Peters then discusses the systematic arrangement of the family, and shows that it embraces ten generic forms, seven of which are new. Among other characters he relies on the form of the tentacle, which may be valve-shaped, globular at the extremity, or acute. He finds that the generic name *Rhinatrema* was proposed on an immature *Ichthyophis*.——In another paper Prof. Peters[2] describes two new species of *Œdipus*, one

[1] Ueber die Eintheilung der Cæcilien, und insbesondere ueber die Gattungen *Gymnopis* u. *Rhinatrema*. Nov., 1879.

[2] Monatsberichte Berliner Akademie, August, 1879.

from New Grenada, the other from Hayti. If the latter locality is correct, it gives an entirely new distribution for the genus.—— It is now some time since M. Fernand Lataste of Paris, showed that the larvæ of the *Batrachia Anura* with opisthocœlous vertebræ have their branchial fissure median, while those with procœlous vertebræ have it on the left side. In a more recent paper[1] this author discusses the position of the genus *Discoglossus* in the system, and gives much new information respecting the habits, varieties and larvæ of the *D. pictus*. He adopts the system proposed by Cope in 1864, in which *Discoglossus* is placed with *Bombinator* and *Alytes* in a special section of the *Anura*, apart from the ranoid and pelobatoid types. M. Lataste creates a number of new names. The distinction in the articular character of the vertebræ had not been used by Cope as the basis of a primary division on account of its uncertainty in some *Cystignathidæ*, but M. Lataste adopts an opposite course. He also gives tribal names to the group with and without ribs, which, in our opinion, increases nomenclature unnecessarily. For this reason we commend his rejection of the new names proposed by M. DeLisle.

Osteological Contributions.—Prof. Allen, of Philadelphia, has recently made some interesting observations on the ethmoid and turbinate bones of the Chiroptera, which are noticed in the Bulletin of the Museum of Comparative Zoölogy, Cambridge.[2] Among other things he finds that in the *Pteropidæ*, *Nycteridæ* and some *Phyllostomidæ*, a horizontal plate extends "from the under free edge of the vertical plate" of the ethmoid "to the nasal septum. The olfactory surface in such forms is thus withdrawn from the respiratory currents, since no direct outlet exists at the posterior nares."——Prof. E. D. Cope has recently published in the Proceedings of the American Philosophical Society,[3] a description of the foramina which perforate the temporal and adjacent parts of the parietal bones of the *Mammalia*. He finds nine of these which are generally constant in position, but present great variety in their occurrence in the different orders, families and genera. Three of them are confined to the *Menotremata* and *Marsupialia*, while there are many of the higher types which do not possess any of them. The largest number is present in the equine *Perissodactyla* and the *Ruminantia*. Prof. Cope's conclusions are stated as follows:

(1.) The sinous foramina furnish valuable diagnostic characters, and may, with proper limitations, be used in systematic definition.

(2.) The primitive condition of the various Mammalian orders, appears to have been the possession of a limited number of these formina.

[1] Actes de la Société Linneenne de Bordeaux, XXXIII, p. 275, 1879.
[2] Vol VI, No. 5, Feb., 1880.
[3] No. 105, March, 1880.

(3.) The Monotreme-Marsupial line have developed a number of foramina in their own special way.

(4.) The *Rodentia* have chiefly developed those of the inferior part of the squamosal bone, if any.

(5.) The *Carnivora* commenced with but few foramina, and have obliterated these on attaining their highest development.

(6.) The history of the *Quadrumana* is identical with that of the *Carnivora*.

(7.) The *Perissodactyla* present very few foramina in the lowest forms, and did not increase them in the line of the *Rhinocerida*. In the line of the horses an increase in their number appeared early in geologic time, and is fully maintained in the existing species.

(8.) In the Omnivorous division of the *Artiodactyla* time has obliterated all the sinous foramina. In the camels an increased number was apparent at the same geologic period as in the history of the horses (White River or Lowest Miocene), and has been maintained ever since; while the existing *Pecora* present a larger number of the foramina than any of the class of the *Mammalia*.

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GENERAL NOTES.

BOTANY.

THE HUMBLE BEE A DYSTELEOLOGIST AMONG ALPINE FLOWER VISITORS.[1]—In the interesting article of which this is an abstract, Dr. Hermann Müller considers the disteleological actions of the alpine humble bee *(Bombus mastrucatus)*.

As Haeckel has shown, structures which are useless or harmful to the possessor are at once the most insurmountable obstacles to teleology and the finest foundation for disteleology. Very important among these are rudimentary organs; but this field is much more comprehensive than Haeckel made it, or, indeed, could have made from his morphological standpoint, for rudimentary organs are always at first the morphological results of biological causes, and may always be traced to some change of habits in living beings. Their uselessness begins not with the commencement of atrophy, but with the change of habits which is the cause of this atrophy.

The different living beings of any given place are so variedly and closely connected by their mutual relations that a change in the habits of one species is indicated not only by the consequent uselessness of its own organs but also by the accompanying uselessness of those of other species which were closely adapted to it under former conditions. The numerous, well-determined mutual relations existing between flowers and insects serve especially well

[1] "Bombus mastrucatus, ein Dysteleolog unter den alpinen Blumenbesuchern." Dr. Hermann Müller, Kosmos, Band III, Heft 6, p. 422.

in the study of disteleology. The closeness of these relations Dr. Müller has shown in previous articles.[1] Any change in the one must react on the other and produce some effect. For example, no teleologist could desire a more perfect adaptation of two forms one to another than is afforded by the sucking mechanism of the humble-bee and the complicated lever-work for securing pollination in the meadow-sage. But if it chance—and this is really the case in some places—that there are found with the ordinary form of this sage small-flowered varieties which are visited, on an average, later than the large-flowered form, and therefore are fertilized by pollen taken from the latter, the beautiful lever-mechanism of the anthers in the small flowers becomes useless at once, and passes from the province of teleology into that of disteleology; it becomes a rudimentary organ, and as such is actually found in all degrees of atrophy. Or, again, if a species of humble bee belonging to the most frequent visitors of these flowers should find it too much trouble to set the anther-levers in motion, and should take to perforating the floral envelopes from the outside and through these stealing the nectar, it would not only cease to employ its tongue in a way fully corresponding to the degree of its development, but it would render the anther-mechanism of the flowers entirely useless in all of its visits. Indeed, were the not improbable case to occur, in which other species of bees, finding the nectar constantly gone from these flowers, should entirely lose their habit of visiting them, the flowers would never be fertilized, and the meadow-sage would die out in the regions where this occurred. The change in habits of the piratical bee would thus have as a result the changing of the habits of all other humble bees; and from the moment when this occurred the wonderful contrivances by which no insects but these bees can fertilize the flowers would become not only useless but absolutely destructive, and this, without the formation of rudimentary organs. Such a bee, obtaining nectar by robbing from flowers adapted to its visits for their fertilization sets at nought the theory of teleology, and merits in a high degree the name of a disteleologist.

Of this character is the *Bombus mastrucatus* of the Alps; which, moreover, does not content itself with breaking into and stealing nectar from flowers which it cannot enter in the normal way, but has become so addicted to the exercise of violence that it only enters a flower regularly when this is less trouble than perforating its corolla.

The good deeds of this insect, and those by which it is connected with the theory of teleology, are few in number, and confined almost exclusively to such flowers as those of the Compositæ, which are not especially adapted to bees, but are open to the visits of all insects. But while it visits these in the normal way—

[1] See the NATURALIST for April, 1879, p. 257.

because it would be more trouble to get at their nectar in any other—its more ravenous appetite and greater dependence upon plant-food are the only causes which render its visits more frequent than those of less-specialized insects, and its value to the plant greater; for visit for visit, they are as effective in fertilizing the flowers as it is. Such flowers as those of *Thymus serpyllum*, which are only slightly modified, are not as a rule perforated; nor are pendant flowers like those of *Campanula rapunculoides*. But of bee-flowers like those of *Aconitum napellus* very few are visited regularly before a systematic perforation of their corollas is begun. In a few other cases where this bee either leaves the nectar untouched or obtains it by force it collects pollen, and in so doing aids in the fertilization of the flowers.

Were we only to count the flowers which this bee visits in the normal way, and those which it perforates, we might infer that its good and evil deeds stand pretty evenly balanced; nevertheless it would always remain a disteleologist because it seldom uses its own organs in a way corresponding to the completeness of their development, and, moreover, breaks ruthlessly through the most highly developed floral structures, so that to a certain extent both its own organs and those of the flower are rendered useless. But to fully appreciate its injuriousness we must note how greatly it prefers those richly nectariferous flowers which it perforates to those with less nectar which it visits normally. So great is this preference that it is astonishing to see how few flowers of such species as *Salvia pratensis* remain unperforated.

Bad in itself, this habit of perforating flowers is rendered still worse for the plants by the habit which certain other insects have of obtaining nectar through openings already formed, though they would not form any for themselves. This limits still more the number of useful visitors of the flowers. Hence it is not improbable that this bee may have been the cause of the extinction of many alpine plants; and one can scarcely doubt that changes in flowers which tend to check or stop perforation by it have been taken up and developed by natural selection from the time when this unnatural action first began. An instance of partial protection against this bee is afforded by *Rhinanthus alectorolophus*, where the inflated calyx and the firm, smooth arch of the corolla together protects the flowers from forcible removal of their nectar, and force the bee to aid in their fertilization or go without the sweets. In *Pedicularis verticellata* the perforation of the floral envelopes is partially prevented by the globular form of the calyx, the abrupt, rectangular bend of the corolla within, and its smooth, laterally compressed condition without the calyx.

It is easily seen why rudimentary organs are not formed in flowers robbed of their nectar by our bee; for bee- and butterfly-flowers which are thus treated either receive enough visits from other species to ensure their fertilization and prevent the abortion

of their organs, or their other visitors are crowded out to such an extent that the plant perishes at once, giving no opportunity for the formation of any rudiments. Nor can the sucking apparatus of the bee become rudimentary, for it is employed constantly in obtaining nectar even from those flowers which are broken into. Only in case the robber-bee formed the habit of biting off all nectar-containing parts, or of stealing honey already collected by other bees, could its tongue become abortive. What would occur in the the latter case is seen in the Brazilian *Trigona limæ*, which has this habit. The disused tongue is here very small, while the mandibles, being more frequently used, are unusually large and strong.—*W. Trelease.*

Botanical Notes.[1]—The *Botanical Gazette*, for December, furnishes articles by C. C. Pringle, on dimorpho-dichogamy in *Juglans cinerea*, and on the leaf propagation of *Nasturtium lucustre*. To the January number Dr. Gray sends notes on Tennessee plants and records the occurrence of Littorella and Schizæa in Nova Scotia. Dr. George Engelman writes on *Catalpa speciosa*. In the February number are notes on *Viola tricolor* by Prof. T. C. Porter.——To the *Bulletin* of the Torry Botanical Club, for December, 1879, Mr. Pringle contributes notes on Northern New England plants, and *Aspidium spinulosum* is noticed critically by Mr. B. D. Gilbert. The death of Dr. F. J. Bumstead, a student of vegetable anatomy and physiology, which occurred November 28th, is also announced.——The *California Horticulturist* always contains a good deal of botanical matter of general interest; to the January number S. B. Parish contributes a notice of the Pentstemons of Southern California——In Trimen's *Journal of Botany*, for January, is a plate representing a curious pitcher plant (*Nepenthes dyak*), and an article by G. Nicholson on *Spergula arvensis*. Reference is made to an article by P. Sagot on the influence of the hygroscopic state of the air on vegetation. The death of Dr. H. Bauke, December 15, is announced. He was well known by his work on Pycnidia, fern prothallia, &c.——The January number of the *Quarterly Journal of Microscopical Science* contains several botanical articles of special value. H. M. Ward discusses the embryo-sac and development of *Gymnadenia conopæa;* the pollen-bodies of Angiosperms are treated of by F. Elfving; the development of the conceptacle in the Fucaceæ, by F. O. Bower. In his article on the Bacillus of leprosy, G. A. Hansen describes and figures Bacilli found in leprosy tubercles and pus, but does not go so far as Neisser and Edlund in attributing this loathsome disease to these microphytes.——Contrary to Darwin's conclusions that Drosera is carnivorous, Prof. Regel finds, on comparing a number of plants fed with meat with a series which were not, that while the average weight of the seeds was greater in the former case, this was more than compensated by their much smaller

[1] A portion of these notes were crowded out of the March number.—Editors.

number, the gross weight being considerably less. He found also that the leaves were obviously injured by the flesh food and that the power of the plants to resist the winter was diminished. He thinks the epithet "carnivorous" to be inappropriate. On the other hand, Von Heldrich, according to the *Journal* of the Royal Microscopical Society, has found a Pinguicula on the upper side of whose leaves are a large number of bodies of insects in an earlier or later stage of digestion by the glands plentifully sprinkled over its surface. This is the first insectivorous plant yet recognized in Greece.——By the will of the late Stephen C. Olney, of Providence, R. I., his herbarium of from 8000 to 10,000 species of plants, and his library of botanical works numbering some four hundred volumes, and an excellent microscope, with $10,000 for the increase of the library and herbarium, have been bequeathed to Brown University. The library contains many costly works. The herbarium comprises, besides a fine series of Carices, on which the donor bestowed much labor, many Western and South-western plants named by Gray, Cuban plants, Austin's, Sullivant and Lesquereux's mosses, and good series of algæ and lichens. The author's botanical labors were recognized some years since in the establishment of the genus Olneya. The College also receives from him the sum of $25,000 for a professorship of natural history.

ZOÖLOGY.[1]

TWENTY-SIX DAYS AT SEA, IN AN OPEN BOAT, CRUISING FOR WHALES.—We left San Francisco on a small steam propeller known as the *Rocket;* length about thirty-five feet, eight feet beam, and about five and a-half tons register.

The day we left being fine, we had a very pleasant trip as far as Point Reyes, which is about thirty-five miles north of San Francisco, but saw nothing of importance on the way, except now and then numerous albicore and the porpoises sporting in the sea. We anchored in Drake's bay for the night. Early on the following morning we steamed up and took a cruise outside, and in a few hours heard the familiar sound, "There she 'blows,'" and the captain, with spy-glass in hand, answering, "Where-away?" with the answer, "Just on the lee bow, about half a mile ahead!" Getting everything in order, we steered for him, and soon saw several whales swimming very fast and going northwards. Now one approaches which proves to be a sulphur bottom whale (*Sibbaldius sulphureus* Cope), seventy-five to eighty feet long, just under the bow of the boat, in fact almost too close for a shot. The captain fired one of the well-known Fletcher, Suits & Co. California whaling rockets, and patent bomb lance. This apparatus consists of a gun-metal cylinder filled with a peculiar composition made only by themselves, to which is attached, in front, a bomb

[1] The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

with a barbed point; inside the bomb (Fig. 1) is an explosive

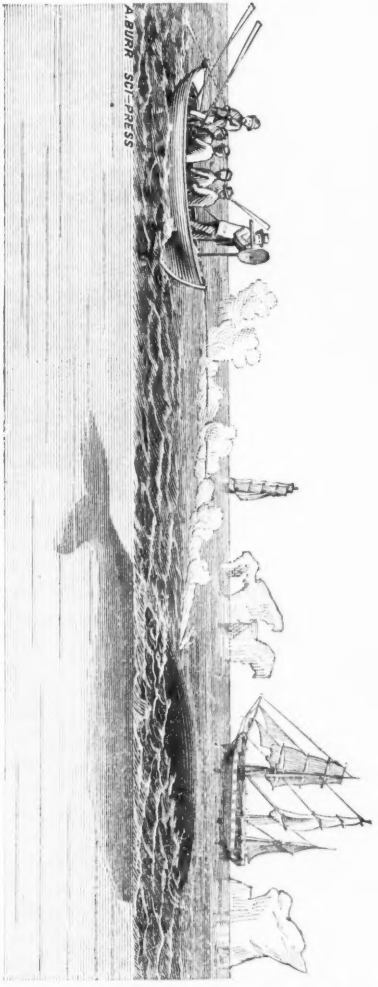

Fig. 3.

California Whaling Rocket and Patent Bomb Lance.

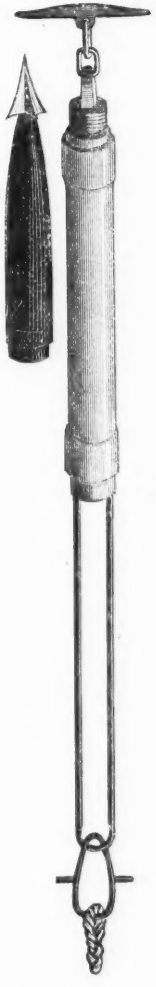

Fig. 1.

Fig. 2.

charge and a chain toggle, which is released by the bursting of the shell on entering the whale; an iron shaft is attached to the rear end of the rocket (as shown in Fig. 2) through which the whale line is spliced, this also shows the chain toggle after it is released, so that when it is inside of a whale it has a sure hold. In some experiments with these bombs on the beach before starting, one carried a whale line, of two and a-half inches in circum-

ference, about sixty fathoms, which shows what power they have, since a bomb and twenty fathoms of line weigh about fifty-five pounds.

These are generally fired from the bow of the boat. Fig. 3 gives a good idea of a man firing at a whale. Fig. 4 gives an enlarged view of the complete apparatus before being fired. The hinged flange is thrown up by the rocket passing out, protecting the face from injury. At a distance of from twenty to thirty fathoms it is almost sure to explode and kill the whale, if it hits him, but in our case, we being too close to the whale, about ten feet distant, the bomb went through him, just abaft of the flukes, and bursted on the outside, leaving the toggle on the outside of him; we were now fast, and the whale towed the propeller, which would, perhaps, weigh ten tons, coal and all, for three or four hours, with from twenty to forty fathoms of whale line, sometimes at the rate of ten miles an hour, although we were frequently backing under a full head of steam. This, if we were going ahead and nothing to hinder, would carry the propeller about ten miles an hour, thus showing the immense strength of the whale.

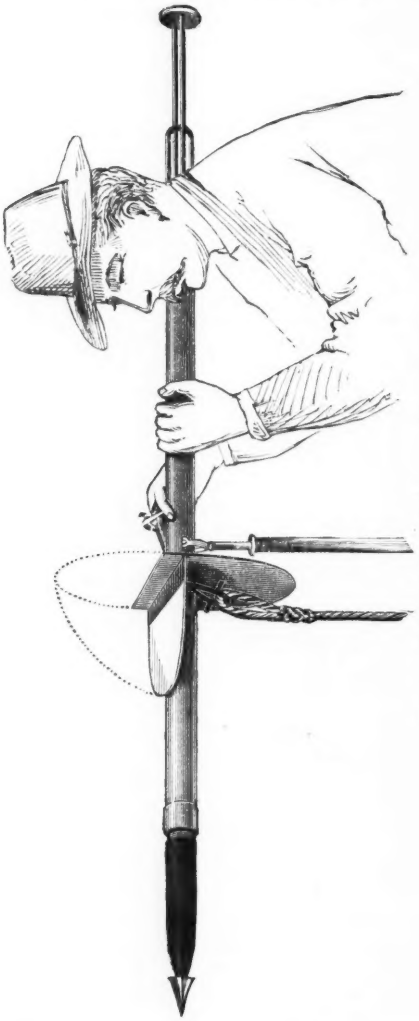

FIG. 4.—Enlarged view of the complete apparatus.

This species of whale is seldom attacked by the whalers on

account of its being so much swifter than any other whales known. We held on to him as long as we could, hoping he would soon give up, as he was going so fast and at such a distance from us, we could not get another shot at him, and it being near sundown, and we over ten miles from land, we commenced to shorten up the line as much as possible intending soon, if he did not give up, to cut the line and let him go. While doing so the line parted, and we lost about ten fathoms and the rocket. Thus ended one of the fastest and most exciting rides I ever had behind one of the monsters of the deep.

We now steamed towards Drake's bay, where we anchored for the night.

On a subsequent day we went out and saw numerous sulphur bottoms, but all swimming fast and going northward. We could scarcely approach them, but finally, firing a shot at one, we missed him. We did not get any more chances at them during the day, and at night returned to Drake's bay.—*C. D. Voy.*

List of Californian Reptiles and Batrachia collected by Mr. Dunn and Mr. W. J. Fisher in 1876.—The following species were collected by Mr. Dunn in a district about seventy-five miles south-east of San Diego:

Batrachia.

Plethodon croceater Cope.

Ophidia.

Crotalus lucifer B. and G.

Lacertilia.

Cnemidophorus tessellatus sub. sp. *tessellatus* Say.
Callisaurus dracontoides Blainville.
Uta thalassina Cope.
Uta stansburiana B. and G.
Uta ornata B. and G.
Sceloporus clarkii subsp. *zosteromus* Cope.
Phrynosoma coronatum Blainville.

The following were collected in Lower California, at or to the south of Magdalena bay, by Mr. W. J. Fisher:

Batrachia.

Batrachoseps attenuatus? La Paz.

Ophidia.

Hypsiglena ochrorhyncha Cope.
Rhinochilus lecontei B. and G.

Lacertilia.

Chirotes sp.? La Paz.
Cnemidophorus maximus Cope.
Phrynosoma regale Gir. Las Animas bay.
Dipsosaurus dorsalis Hallowell.

Prof. E. D. Cope has kindly identified the rarer species, and has verified the identification of the others.

The single example of *Plethodon croceater* is, I am told by Prof. Cope, the only one now known to be extant.

Uta thalassina, a very rare species, is represented by two specimens.

The occurrence of Chirotes in Lower California has been previously noted by Prof. Peters, of Berlin, but as his papers upon the subject are not accessible to me, I cannot be certain to which of the two described species the specimens belong.

The *Batrachoseps* appears to be *attenuatus*, and if so, proves that species to have a more southerly range than has been hitherto supposed.—*W. N. Lockington.*

The Gastrula of Vertebrates and the Gastræa Theory.—The amount of attention now being given to embryology is very great, and of papers and memoirs upon this topic there is no end, while the subject is still apparently in its infancy. To Haeckel, who first showed that all animals above the Protozoans pass through a so-called morula and gastrula condition, much of this recent activity is due. However crude and open to criticism much of his work may have been, he has marked out a new line of investigation, and his gastræa hypothesis has been, with all its necessary assumptions and crudities, most fruitful in results. His early generalization that most if not all many-celled animals pass through the condition of a two-layer sac with a primitive opening and digestive canal (his gastrula) has been sustained by Balfour, Lankester, Kuppfer, Benecke, and others. The observations of the two last named authors on the salamanders, lizards and turtles have enabled them to extend the gastræa theory into the great division of the Amniote Vertebrata, and, it is claimed, does much to explain the phylogenetic history of the allantois. A gastrula state is now known to be common to Amphioxus, the lamprey, sharks, ganoids, bony fishes, as well as to all higher vertebrates. Kuppfer and Benecke have discovered that in the embryo turtle the gastrula-cavity is continued into the intestine (or hind gut) and that therefore it forms the rudiment of the allantois.

Zoölogical Notes.—A. D. Michael states in the *Journal* of the Royal Microscopical Society that after placing some Oribatid mites in one per cent. solution of osmic acid for several hours, and then putting them in fifty per cent. alcohol for several more hours, and finally in absolute alcohol for several additional hours, they came out, naturally to his surprise, "all alive and apparently not much the worse."——M. Dareste states that the amnion is occasionally absent in the embryo chick, though the germs would probably not live to break the shell.——In a paper on the locomotion of land snails, Dr. Simroth discusses the action of the muscles of the foot and their relation to the nerves, and draws attention to the interesting relations between the circulatory system and the locomotor muscles. It seems that the foot of the slug can only contract so long as it is swollen out by blood, the sinus in the middle line of the foot forming a veritable *corpus*

cavernosum.——Three species of Helix having been shown to be viviparous, a fourth (*Helix studeriana*, from the Leychelles) has been found by Vignier to bring forth its young alive.——The so-called proboscis of Pterotrachea, a Heteropod mollusc, has been found to possess organs of taste, the gustatory papillæ having, it is claimed by Todaro and Milone, the same structure as those of the Mammalia.——Indications of the molting of the horny beak of a penguin (Eudyptes) were presented to the Zoölogical Society by Dr. Mulvany.——It appears that the Phylloxera in France resisted the severe cold and deep snow of the past winter, the temperature in December having been below 10° and 12° F. No remedies have yet proved successful in dealing with this dreadful pest.

ANTHROPOLOGY.[1]

American Ethnology.—In the history of every science there are periods when the student may lay aside the apparatus of the investigator and bring together the results of varied researches into one general view. Such an opportunity offered itself, and was well utilized, when Mr. John D. Baldwin, profiting by the labors of Schoolcraft, Squier and Davis, Stephens, Catherwood, the earlier Government surveys, and the Smithsonian Institution, as well as the older authorities, published, in 1871, his "Ancient America."

A personal familiarity with the very arena on which the history of the Mound-builders was enacted, and the accumulation of new materials, induced Dr. J. W. Foster, in 1873 to publish his "Prehistoric Races in the United States."

Since the explorations, upon which this work is based, were made, the Smithsonian Institution has continued to publish additional facts every year; the Centennial Exhibition has added fresh enthusiasm to archæological research, the Government surveys have brought to light the old civilizations of the Colorado valley, Dr. Rau has published his "Archæological Collection of the U. S. National Museum," the Peabody Museum, the Davenport Academy, and many other State institutions have sent forth the results of their special investigations, and finally, Mr. Bancroft's "Native Races of the Pacific States," has brought together about all that is valuable in the pages of its predecessors. Taking advantage of these accumulations, Mr. John T. Short, of Columbus, Ohio, has just brought out, through Harper & Brothers, a new summary entitled, "The North Americans of Antiquity: their Origin, Migrations, and the type of civilization considered."

The work consists of eleven chapters, treating of the ancient inhabitants of the United States, antiquity of man on the Western continent, origin of the ancient Americans, especially the Mound-builders, the Pueblos and Cliff-dwellers, the Mayas, and

[1] Edited by Prof. Otis T. Mason, Columbian College, Washington, D. C.

the Nahuas, old world analogies with ancient American civilization, chronology, language, and finally, the possible methods of peopling America from the old world.

Since the author laid aside his authorities to abide with the printer, several very important contributions have appeared which would have thrown light upon his discussions, and which he, no doubt, would have been the first to utilize; notable among these are, "Habel's Sculptures of Santa Lucia," "Rau's Palenque Tablet," "Anales del Museo Nacional de Mexico," the writings of Bandelier, Icazbalceta, Stephen Powers, A. S. Gatschet, Col. Mallery, and above all, the immense linguistic and ethnographic material now collecting at the Bureau of Ethnology in Washington, under the direction of Major J. W. Powell.

But investigation must cease somewhere, and the author has produced, from the material at hand, by far the best summary of ancient North America which has yet appeared. We have followed him with great trepidation from the beginning to the end of his perilous undertaking, along the dizzy heights, the narrow ledges, the yawning abysses and the tumultuous floods. He has, at times, been lost to our view, and again seemed falling into the devouring torrents. We could hear some of our brethren shouting, "Climb a little higher!" "Stoop a little lower!" "Lean to the right!" "Lean to the left!" "Come my way!" But on the whole, Prof. Short has made a successful trip, though, doubtless, feeling much as Maj. Powell's party did when they emerged from the cañons in 1869, or like Dr. Grove, who closes his Greek dictionary with the ejaculation, "Glory to God."

The opinions most strenuously advocated are: 1. That the Mound-builders were not red Indians; 2. That they were related to the Nahuas of Mexico; 3. That man is not autochthonous in America, that the claims of excessive antiquity are not valid, in fine, that he has not been upon the continent over 3000 years; 4. That the multitudinous theories of European and Asiatic migrations, of which a very complete list is given, while valuable as traditions, lack confirmation; 5. That the ancient Americans were not a single race, as held by Morton; 6. The very high degree of artistic and scientific knowledge possessed by the Mayas and Nahuas; 7. The value of Landa's Syllabaries in the future decipherment of Maya hieroglyphics; 9. The great merit of the Maya-Quiche literary remains. "The poetry of the Quiche cosmogony must some day find expression in verse of Miltonic grandeur. The fall of Xibalba will, no doubt, afford the materials for an heroic poem which will stand in the same re lation to America that the Iliad does to Greece. The doctrines of the benign and saintly Quetzalcoatl, or Cukulcan, must be classed among the great faiths of mankind, and their author, alone of all the great teachers of morals, except Christ himself, inculcating a positive morality, must be granted a precedence of most of the

great teachers of Chinese and Hindoo antiquity;" 10. "While the probability is preëminent that the ancient Americans are of old world origin, and that the Mayas and Nahuas reached this continent from opposite directions, it is certain that the civilization developed by each people is indigenous."

PERUVIAN ANTIQUITIES.—Those who have read with pleasure Squier's "Peru," published by the Harpers in 1877, will, no doubt, be delighted to see the following title and table of contents of the most thorough work on Peruvian antiquities that has yet appeared:

Wiener, Charles. Pérou et Bolivie. Récit de voyage suivi d'etudes archéologiques et ethnographiques et de notes sur l'ecriture et les langues des populations indiennes: Ouvrage contenant plus de 1100 gravures, 27 cartes et 18 plans. Paris, Librairie Hachette et Cie., 79 Boulevard Saint Germain, 1880. Droits de propriété et de traduction réservés. In 1875 M. Wiener was sent by the Minister of Public Instruction of France to Peru and Bolivia upon an archæological and ethnographical mission to last two years. The observations of the author are classed into four groups: 1. Account of his travels; 2. Archæological researches; 3. Observations upon ethnography; 4. Linguistic studies. In giving an account of antiquities, M. Wiener observes that he does not take upon himself the office of the panegyrist nor that of the detractor, but confines himself to an accurate account of the witness of these ancient civilizations, dividing them into three classes, architecture, sculpture and decoration (peinture).

GEOLOGY AND PALÆONTOLOGY.

NOTE ON THE ANDROSCOGGIN GLACIER.—Traces of a local glacier along the valley of the Androscoggin, from the White mountains to West Bethel, Maine, were first discovered by Prof. A. S. Packard, Jr., and Prof. G. L. Vose, and described by them in the first and second volumes of the AMERICAN NATURALIST. The flow of this glacier was subsequent to that of the great ice-sheet. More recently Prof. C. H. Hitchcock has described the glacial drift of this region in the New Hampshire Geological Reports. He also found abundant traces of such a glacier.

During June, 1879, while studying the modified drift of the Androscoggin valley, the writer incidentally noted the signs of the local glacier. The most unique morainal mass which I found in the valley has not, so far as I know, heretofore been described. It is on the south side of the river, just at the State line. The Androscoggin which has been for a mile or two running south-easterly, here abruptly bends to the north-east. Here also the State Line brook, a roaring stream eight or ten feet wide, comes in from the south. It drains a wide mountain basin which inclines down to the Androscoggin by a moderately steep slope. This slope shows a short terrace near the steam; otherwise it is

covered with ordinary glacial till, with the exception of a mass of loose morainal materials lying in the woods a short distance east of the brook. A number of white birches and poplars led me into the thicket under a suspicion of kames, and thus I stumbled upon this deposit. Its southern portion (it is separated into two parts by a depression) consists of a ridge from five to fifteen rods wide and rising from ten to thirty feet above the surrounding slopes of the hill. Here are some granite bowlders, closely resembling, if not identical with the outcrop of gneiss found a short distance west of here, near the river. The northern portion consists of a V-shaped mass with the apex south. It is composed of two ridges making the angle of 60° with each other, which are connected on the north by an irregularly curved ridge, the whole enclosing a shallow funnel or "potash kettle." Of these the western ridge is prolonged somewhat to the north of the cross ridge in the form of a row of conical hillocks which reach down nearly to the upper terrace of the river valley. This western ridge is nearly in line with the southern ridge first described (perhaps they are really one ridge), and both bear nearly due magnetic north, thus crossing the State line obliquely. From the eastern ridge a short spur juts to the south. The northern end of these ridges must rise fifty or more feet above the underlying hill. The ridges all slope outward in all directions, often as steeply as loose materials will lie.

By aneroid the height of the ridges above the river varies from 180 to 200 feet, and perhaps there were places a little higher than those measured. In places the materials show signs of water-wash, with a loose structure as of gravelly upper till. Along the south bank of the Androscoggin are many morainal masses left by the great glacier, but this is evidently a very different deposit. Considering the shape of the mass, its situation, its height, its materials and the steepness of its slopes, I regard it as a moraine of the local glacier. It is one-third of a mile long and at one point is about one-eighth of a mile wide.

The significance of this moraine becomes more evident after examining the north side of the river opposite. Here a high hill called Hark hill, stands far out into the valley in the angle between the Androscoggin and a stream that comes in from the N. N. W. Hark hill is separated from the cliffs that form the northern walls of the Androscoggin valley toward the north-west by a low valley in which is found an extensive moraine. This deposit ends on the east and north-east in a steep bank or bluff from twenty to forty feet high, overlooking the interval of the lateral stream above mentioned. It contains many angular bowlders and sometimes an angular gravel, as if little water worn. This deposit is not valley drift, and for the most part does not appear to be ordinary till. I marked it as a lateral moraine of the valley glacier, though not very positively. Its height was

not measured, but cannot be much, if any, more than one hundred feet above the river. No grooves of the local glacier could be found on the north side of Hark hill, though they are beautifully developed everywhere on the south side of the hill next the river.

On the south-east shoulder of Hark hill is found a morainal ridge. It bears N. 20° W., which was so near the direction of the flow of the continental glacier that I carefully examined the northern end of the deposit to see if it was a "tail" to a spur of the hill. It ends on the north at a height by aneroid of about one hundred and ninety feet above the river, terminating as a steep ridge of loose materials piled up to a height of ten or fifteen feet above the surrounding slopes of the hill. Its length is about one-fourth of a mile. It is evidently a moraine of the local glacier, and is described as such by Prof. Hitchcock.

Here then at this bend of the river, at the State line, are two remarkable moraines lying transverse to the valley and directly opposite to each other. Each begins at a point about two hundred feet above the river and reaches down nearly or quite to the upper terrace of the valley drift. The larger moraine is on the south side of the river, and almost in a line with the glacier's axis for a mile or two up the valley. It appears as if the local glacier here paused in its recession for a time long enough to form a terminal moraine of considerable size. That part of the moraine which was within reach of the swollen river would naturally be washed away or buried out of sight during the period of the deposition of the valley drift.

We have already referred to the lateral valley that comes from the N. N. W. past the north-east base of Hark hill. In the lower part of this valley is an arrangement of the modified drift which deserves notice. Here is a plain composed of steepish reticulated ridges of sand, gravel and pebbles, enclosing a small pond and numerous funnels. The external appearance of these ridges is decidedly kame-like. Their tops are on nearly the same level as the upper terrace along the river, and in fact they appear like an extension of the drift of the Androscoggin valley running back into this lateral valley for a half mile. They then drop down suddenly into a wide, level interval which reaches entirely across the valley and shows no distinct signs of terraces, at least on the south side. This interval shows hardly a pebble, nothing but a fine silt of great fertility. Time did not permit its exploration, but I was informed that it reaches two miles or more back from the river. For the first half mile from the river the lateral stream has eroded thirty or more feet into the valley drift and kame-like ridges, but its flood plain is not many rods wide. Then comes the wide interval, and although the stream meanders through it by several channels, yet the size of the interval, the fineness of its materials, and the absence of well-defined terraces,

make it very unlikely that this low flat was excavated in valley drift. At least, if so, the drift must have been of unusually fine materials.

The currents which deposited these kame-like ridges may have swept toward the Androscoggin valley or away from it. The abruptness with which the ridges end on the north-west, favors the latter theory, though this could not be confirmed by lines of stratification, as no fresh exposures could be found. At Shelburne the valley of the Androscoggin abruptly widens, and there has evidently been a lateral sweep of the currents, but I nowhere in the valley saw these oblique ridges actually turning back toward the west unless it be here at the State line. The appearances could be accounted for by supposing that during the deposition of the valley drift, in times of sudden flood, powerful currents overflowed into the lateral valley until it was filled with water. Coarse materials would be carried for a limited distance and the finer would be deposited over that wide interval, which would for the time being be a lake. Or it may be that a part of these ridges were true kames, deposited in ice channels along the flanks of the valley glacier during its final melting. In any case it is difficult to see how the currents could have come from the north-west without leaving some traces of gravel ridges in that direction.

Thus far no decisive evidence can be found that the Androscoggin glacier flowed eastward of West Bethel. Many morainal ridges cross the valley but none of them appear to have been deposited by the local glacier, unless it be a line of hillocks and ridges just west of the valley of the Sunday river, below Bethel. A minute examination may show this deposit to be a moraine of the Androscoggin glacier.—*George H. Stone.*

Marsh on Jurassic Dinosauria.—In the March, 1880, number of the *American Journal of Science and Arts*, Prof. Marsh gives an account of the Dinosaurian *Stegosaurus ungulatus*, of which he has come into possession of an unusually complete skeleton. He finds the genus to be possessed of very distinctive characters, which are as follows:

"(1.) All the bones of the skeleton are solid; (2.) The femur is without a third trochanter; (3.) The crest on the outer condyle of the femur which in birds separates the heads of the tibia and fibula, is rudimentary or wanting; (4.) The tibia is firmly coössified with the proximal tarsals; (5.) The fibula has the larger extremity below." Prof. Marsh abandons the order *Stegosauria* which he formerly proposed, and refers the genus to the *Dinosauria*, to a special group. *Stegosaurus ungulatus* was thirty feet long, and walked on its hind limbs; its back was protected by bony scuta, and its food was probably vegetable.

Archæopteryx.—In 1863 M. Häberlein discovered in the lithographic stone of Solenhofen (Bavaria) a fossil bird, the Archæop-

teryx, which was described by Owen, and a restoration of it is to be found in several of the recent manuals of Geology. More recently, M. Häberlein, Jr., has found in the same place another slab containing a complete and most perfect specimen of Archæopteryx. The examination of that specimen modified some previous conclusions. The wings are spread out as for flight. Two small, pointed, conical teeth are implanted in the upper jaw. The hands cannot be compared with those of a bird or of a pterodactyl; they resemble those of a three-fingered lizard. The fingers are long, slender and provided with sharp claws. The wing-feathers (remiges) are attached all along the outer side of the arm and hand; had they not been preserved, no one would have suspected, from the examination of the skeleton alone, that the animal was winged. The remiges do not overlap each other; the proximal end of the shaft is covered with down; the outline of the wings is rounded like that of the hen. The head, neck, chest, ribs, tail, thoracic girdle, and front limbs of that fossil are characteristically reptilian; the pelvis was also probably more reptilian than avian. On the contrary, the legs are bird-like; they resemble most those of the falcon, inasmuch as they are covered with feathers. To every caudal vertebra was attached a pair of lateral quills. The remainder of the body was evidently naked and featherless, with perhaps the exception of the base of the neck, where there are indications of a collar of feathers like that of the condor.

Karl Vogt, to whom science is indebted for several of the foregoing facts, says that it is superfluous to discuss the question as to whether the Archæopteryx is a bird or a reptile. It is neither; it is an intermediate type by itself, and confirms the views of Huxley, who classes together the birds and reptiles, under the name of Sauropsida, as one of the great divisions of vertebrates.

The Manti Beds of Utah.—In a previous number (May, 1879) of this journal I showed that the palæontological evidence is opposed to the identification of the "Amyzon" beds of Nevada and Colorado with the Green River formation, and that the former are probably of later origin. There is, however, a series of calcareous and silico-calcareous beds in Central Utah, in Sevier and San Pete counties, which contain the remains of different species of vertebrates from those which have been derived from either the Green River or Amyzon beds. These are *Crocodilus*, sp., *Clastes cincatus* Cope, and a fish provisionally referred to *Priscacara* under the name of *P. testudinaria* Cope. There is nothing to determine to which of the Eocenes this formation should be referred, but it is tolerably certain that it is to be distinguished from the Amyzon beds. In its petrographic characters it is most like the Green River, as it consists in large part of shales. The laminæ are generally thicker than those of Green and Bear River. The genera *Crocodilus* and *Clastes* have not been found heretofore in

Green River beds, although they are abundant in the formations deposited before and after that period. Until its proper position can be ascertained, I propose that the formation be called the Manti beds.—*E. D. Cope.*

THE SKULL OF EMPEDOCLES.—This genus, originally described[1] from vertebræ, proves to be allied to *Diadectes*, and to be one of the most remarkable forms of the Permian fauna. With that genus it forms a family, the *Diadectidæ*. The skull of *E. molaris*[2] displays the following characters:

The relations of the quadrate and zygomatic arches are as in the *Theromorpha* generally. The pterygoids extend to the quadrates, and the vomer bears teeth. The brain-case extends to between the orbits, and its lateral walls are uninterrupted by fissures from this point to near the origin of the *os quadratum*. There is an enormous frontoparietal foramen. The mode of connection with the atlas is peculiar. There is a facet on each side of the *foramen magnum*, which then expands largely below them. The bone which bounds it inferiorly, presents on its posterior edge a median concavity. On each side of this, is a transverse cotylus, much like those of an atlas which are applied to the occipital condyles of the *Mammalia*. They occupy precisely the position of the Mammalian condyles. The median point of their upper border, which forms the floor of the foramen magnum, is produced in the position occupied by the median occipital condyle of a reptile. From its position between the cotyli, the section of this process is triangular. The element in which the cotyli are excavated has the form of the mammalian basioccipital, and of the reptilian sphenoid. It is not the batrachian parasphenoid. Its extreme external border on each side where it joins a crest descending from the exoccipital, is excavated by a circular fossa which looks outwards.

The character of this articulation is so distinct from anything yet known among vertebrated animals, that I feel justified in proposing a new division of the *Theromorpha* to include the *Diadectidæ*, to be called the *Cotylosauria*.

It will be remembered that in *Diadectes* the maxillary teeth are transverse, and molar-like. There is a distinct canine. In *Empedocles* there is no distinct canine, but the incisors are distinguished by their form, having more or less distinct transverse edges. For the present I refer *D. latibuccatus* to *Empedocles*.—*E. D. Cope.*

GEOGRAPHY AND TRAVELS.[3]

THE INTERIOR OF GREENLAND.—The Danish Government having recently instituted an examination by a scientific commission of the interior of Greenland, has now published the first part of

[1] Proceed. Amer. Philos. Soc., Phila., 1878, p. 516.
[2] *Diadectes molaris* Cope, AMER. NATURALIST, 1878, p. 565.
[3] Edited by ELLIS H. YARNALL, Philadelphia.

a report giving the results of these researches. A recent number of the *Nature* (February 12, 1880) gives a *résumé* of the work, from which we take the following:

"The work contains four memoirs of great interest: an account of the expedition upon the inland ice, made by Lieut Jansen in 1878; a record of the astronomical and meteorological observations made during this journey; notes on the geology of the west coast of Greenland, by M. Kornerup; and remarks upon the plants collected by the last named explorer, by M. Lange.

"Starting from the neighborhood of Frederikshaab, in South Greenland, Lieut. Jansen traversed a distance of forty-six miles over the continental ice. Here he found, as did Dalager, who made a similar attempt from the same point in 1751, that a number of islands of rock (Nunatakker) rise above the general level of the great sea of ice, and upon these rocky islets no less than fifty-four species of plants were collected."

Of the character and movements of this great sheet of ice we learn that:

"1. At a distance of 75 to 76 kilometres from the shore, the continental ice attains a height of 1570 metres (5115 feet), and must be of considerable thickness, since its inclination to the east from the Isblink of Frederikshaab averages only 49′.

"2. On that part of the continental ice which has been explored, even at a great distance from the shore, are found many 'Nunatakker,' which influence to a great extent the movements of the ice, in some cases actually bringing about a reversal of the direction.

"3. The surfaces of dislocation resulting from the movement of the ice are almost vertical in the midst of the continental ice, but they incline at the edge and near the 'Nunatakker,' where the slope of the ground is great, and the upper parts of the ice, in consequence, move more rapidly.

"4. The crevasses are partly perpendicular, partly parallel to the direction of the movements, following the nature of the inequalities of the rocky bed, and in places where the ice takes a fan-like disposition, both radial and tangential crevasses are observed.

"5. Around the 'Nunatakker' and the rocks near the shore the surface of the continental ice is impregnated with fine rocky *débris* (sand and clay), which are brought there by tempests, and which brooks carry from a distance to the cavities of the continental ice. The masses of clay thus collected give rise to the pyramids of ice which, near the Isblink of Frederikshaab, attain an elevation of nearly sixty feet.

"6. Moraines of different form are found on the continental ice, especially near the 'Nunatakker,' and they must be referred to the classes of ground moraines and terminal moraines. They frequently form curved or semi-circular lines, and inclose well-

rounded masses of stone of no great magnitude, which in their advance fall into the crevasses."

The exposed rocks along the coast and in the islets which rise above the great ice-sheet are found to be mostly composed of gneiss, with some mica, talc and hornblende-schists, and occasional patches of granite.

New proofs are furnished of the gradual elevation in past periods of the west coast. "Five sets of raised beaches are described occurring at heights of 28, 57, 94, 192 and 326 feet above the sea-level respectively. On the other hand there is clear evidence that the land is, at the present time, slowly subsiding, the extent of this movement being shown to have been at Lichtenfels from six to eight feet since the year 1789."

FINSCH'S EXPEDITION TO THE NORTH PACIFIC.—Dr. Otto Finsch, a naturalist of wide reputation, having recently completed an account of his last journey through Western Siberia, has now undertaken to visit the less known islands of the Northern Pacific. He reached Honolulu in July last. He sends home an interesting account of the effect of the introduction of new species of plants and birds upon the native species. Large numbers of mainas, a kind of starling *(Acridotheres tristis)* have been imported from China, and by driving away the pigeons and fowls, and destroying the nests and eggs of the domestic birds, have become a great nuisance to the inhabitants. The mainas are very active and vociferous, and when gathering by hundreds at their roosting places, the noise is indescribable. The European house-sparrow has also reached the Sandwich islands, and are only second in numbers to the mainas. Another introduced species is the turtle-dove, brought also from China. To find the native birds it was necessary for Dr. Finsch to travel into the interior. Even here they were scarce, and he complains that both the native forests and birds are rapidly being destroyed. On August 21st, Dr. Finsch arrived at the Marshall islands, landing on "Jaluit," or Bonham island. This island being much visited by the natives of the other neighboring and little known islands, afforded him excellent opportunities for his ethnographic studies.

GEOGRAPHICAL NEWS.—A valuable paper, "Observations on the Physical Geography and Geology of Madagascar," accompanied by a physical sketch map, by James Sibree, Jr., was given in *Nature* for August 14, 1879. It contains much new and valuable information about this great island which is the third in size in the world, and nearly four times larger than England and Wales. —— *Nature* notices an amusing mistake in a German scientific work, "Das Leben der Hauskatze und ihrer Verwandten," where the following extraordinary statement occurs: "Die schwanzlose Katze von der Insel Man *im stillen Ocean* wenn nicht das *Kap Man auf Borneo* darunter zu verstehen," etc., thus first placing

the Isle of Man in the Pacific ocean and then doubting its existence, and suggesting it may be a cape of the same name in Borneo!!—— Accurate measurements made by the Russian authorities in the ports of the Baltic, have undoubtedly proved that the level of the sea at Cronstadt is, by nearly two feet, higher than at Reval, and that the height decreases regularly from north to south; this conclusion being fully supported by Prussian measurements at Memel and at Kiel.——The *Revue de Geographie* has recently published some statistics of the census of Japan. Only five cities have over 100,000 population, viz: Tokio 595,905, Ohosaka 271,292, Kioto 238,603, Nagava 125,195 and Kanazava 109,850. Yokohama has only 64,602 inhabitants, Nagasaki 29,660 and Hakodate 28,800.——In a communication to the London *Academy* (January 24, 1880) upon the archæology of Southern Italy, M. Lenormant well says, that "geographers have not hitherto paid sufficient attention to the general fact of the displacement of the centers of population throughout this region at the beginning of the middle ages. The Greek cities were all placed on the sea shore, or at a very short distance from it, in positions favorable to traffic by sea, but ill adapted for purposes of defence. During the centuries when Saracen corsairs were masters of Sicily, and periodically ravaged the coasts of Southern Italy, these positions became untenable, exposed as they were to devastation of every kind. The inhabitants abandoned them and withdrew some five or six miles from the sea, leaving the coast absolutely deserted." "Now, since security has returned to the coast, thanks to the suppression of piracy in Barbary, which continued to desolate these regions until the taking of Algiers by the French, a precisely opposite movement is in progress. The first step was to plant the sea-board and cultivate it afresh without leaving the inland districts. Next, within the last few years, the railway has been constructed which skirts the Ionian sea. Now the inhabitants are gradually descending from the towns built in the middle ages on the heights which, twenty years hence, with the exception of Catanzaro and Squillace, will be in turn almost deserted."——The results of a recent scientific exploration of Sumatra are to be given to the world in a magnificent work embracing four volumes. The geography of the country will be contained in one of these which will also include the meteorology and geology, while the other books will be devoted to the ethnology, natural history and languages of Sumatra and a narrative of the journey. The Dutch edition will first appear, but it will doubtless be translated into one at least of the more widely known languages.——The French Geographical Society are considering the practicability of adopting some uniform system of spelling in their publications, thus quickly imitating the similar resolution of the Royal Geographical Society.—— The New York State Survey has ascertained that in a dis-

trict covering about 2000 square miles, in one of the most populous parts of the State, and containing two important cities and nearly two hundred villages and hamlets, *every one* of these towns or villages is misplaced from one to two miles on all existing maps. The Director, Mr. James T. Gardner, remarks: "Colorado was not a greater surprise to me than has been the structure of my native State. In the study of the origin of some of the most remarkable features lie untrodden tracts of knowledge which are yet to awaken deep interest. The configuration of a part of Central New York is as unique and as unknown to science as that of any part of the Rocky mountains."——"Studien über das Klima der Mittelmeerländer," by Theobald Fischer, published as a supplement to *Petermann's Mittheilungen*, is an exhaustive monograph on the climate of the shores of the Mediterranean. An interesting account of the famous winds, the Maestral, the Bora and the Sirocco, is given with many tables and charts illustrating the records of temperature and rainfall. He also discusses the evidence for change of climate, within historic times, afforded by the fauna and flora. When the African elephant was tamed by the Carthagenians, the camel was unknown in North Africa, whereas now the camel is indispensable on the desert and the elephant and rhinoceros have both disappeared from the region. There is no evidence of such a change in the climate of the countries north of the Mediterranean as would prevent their recovering the position they held in ancient times. The rainfall, though, owing to the destruction of the forests, it is differently distributed, is the same in amount and sufficient for agricultural needs. In the countries, however, lying south of lat. 34° N. greater changes have taken place, the rainfall being decidedly less in amount than formerly. Vast tracts have become uninhabitable, the desert is ever encroaching upon the steppe, the springs are drying up in the oases, and the larger mammals are abandoning the region. Only a local influence could be exerted by the proposed inland sea in Algeria, but the planting of forests might produce greater results. ——Mr. Alexander Forrest, brother of the well-known explorer, Mr. John Forrest, has recently made a successful journey in north-western Australia, during which he explored the country lying between the De Grey and Victoria rivers. Starting February 15, 1879, from the former river and proceeding northwards to King's Sound, the party then followed up the Fitzroy river for a distance of 250 miles. It is navigable for small vessels for about 100 miles. Leaving the Fitzroy at 17° 42′ S. lat. and 126° E. long., they journeyed north-west towards Collier bay for 140 miles, ascending a table land 2000 feet high, but were obliged to return to the river, owing to the ruggedness of the country. They then, on July 10th, started for the overland telegraph line, marching in an E. N. E. direction, and reached the Victoria river near its junction with the Wickham, after a march of 340 miles.

During this part of their journey they discovered a vast extent of fertile country, abounding in grass, and intersected by numerous large rivers, all running north and north-west. Great numbers of natives were seen, and for the most part they were fine, big men, but they had evidently never seen Europeans before. Leaving the Victoria, they came to an almost waterless country, and after terrible sufferings finally reached the Katherine telegraph station. They arrived at Port Darwin on October 6, 1879.[1]

MICROSCOPY.[2]

AGENCY FOR EXCHANGING OBJECTS.—A Microscope Exchange Bureau has been opened by Herman Poole, No. 23 W. Swan street, Buffalo, N. Y. Slides are to be sent to the exchange in quantities of not less than six, and accompanied with a list of desiderata. One of each six will be retained by the agency, and the rest will be exchanged as requested, so far as may be possible.

EXCHANGES OF APPARATUS.—Several subscribers desire to make exchanges of apparatus. A Crouch student's monocular stand, and Schrauer binocular, and several choice lenses are offered, either for a Beck or Crouch binocular, or a Powell & Lealand large monocular, or for lenses of other powers, or for cash. Particulars can be obtained from the editor of the Department of Microscopy of the NATURALIST.

AMERICAN SOCIETY OF MICROSCOPISTS.—The executive committee of this Society have decided to accept the invitation received from Detroit, and the meeting next August will therefore be held in that city. The precise date is not determined at the time of this writing. It is certain that the citizens of Detroit will give a generous welcome to the Society; and a large and important meeting is expected. Correspondence in regard to papers to be offered, or other scientific business of the meeting, should be addressed to the president-elect, Prof. H. L. Smith, of Geneva, N. Y.

OBSERVATIONS ON THE CONSTRUCTION OF THE HUYGHENIAN EYE-PIECE AS USED IN MICROSCOPES.—The difference in the conditions under which the Huygenian eye-piece is used in the microscope, as compared with the telescope, for which it was first devised, and the adaptation of the eye-piece to those conditions, has received but little attention from microscopists, and there are discrepancies in the few statements published in regard to the subject. The following examination of some of the oculars now in use on microscopes was undertaken to determine whether their construction conformed to any general principles. The examination was made by means of a heliostat and focometer, by which the dismounted lenses could be arranged in any position with reference to each other. The lenses being arranged in the foco-

[1] For fuller details of this expedition see *Zeitschrift der Gesellschaft für Erdkunde zu Berlin*, 1879, p. 436.

[2] This department is edited by Dr. R. H. WARD, Troy, N. Y.

meter, light may be sent through them from an aperture of known diameter, and a piece of card or ground glass placed between the lenses at different points to indicate the course of the rays. For measurements, one of J. Moller's photographed micrometers, inserted as an object, is most convenient, the dense black blocks admitting of accurate reading, and the millimeter being a more convenient unit than the line. The magnifying power is ascertained according to the ordinary formula: Divide the product of the focal lengths by their sum diminished by the interval between them; *e. g.*, for the first in the table 30×60=1800, which, divided by 30+60—58=48, the result being slightly too large.

	Maker and Name.		Focal length of eye lens.	Focal length of field lens.	Diameter eye lens.	Diameter field lens.	Distance, plane surfaces.	Distance, lens to diaphragm.	Aperture, diaphragm.	Aperture in cap.	Ratio focal length eye lens to field lens.	Focal length eye piece.	Do in inches (approximately.)	Magnifying power.
1	Beck's Popular.	A	30	60	18	29	53	34	18	7		48	2	4
2		B	21	42	11	24	37	22	15	7		33	1	6
3		C	14	25	7	13	22	14	10	5		20		15
4	Beck's Small Best.	A	30	60	18	30	55	32	18	7		51	2	4
5		B	20	40	11½	24	38	20	15	7		36	1½	6
6		C	14	25	7	13½	24	18	10	5		23	1	10
7		D	8	16	6	12	18	13	8	2½		21		15
8		E	6	12	5	11	11	8	7	2½		10		29
9		F	3	6	5	9	7	6	5	2½		9		30
10	Orthoscopic		12	25	9	17	25	17	12	8		25	1	10
11	"		26	35	11½	31	37					38	1½	6
12	Nachet.	1	30	55	14	20	47	30	13			43	1	5
13		2	20	38	13	20	35	18	13		+	33	1	7
14		3	10	32	10	20	30	17	10			26	1	10
15	Crouch.	A	32	55	18	28	52	35	20	10		50	2	4
16		B	26	36	12	24	37	20	18	8		37	1½	6
17	Oberhauser.	2	32	43	12	19	47	35	14			49	2	4
18		3	29	37	10	20	40	30	15			41	1½	5

(All distances in millimeters except in the column marked "inches.")

By inspection of the table it will be seen that in half the oculars examined the ratio of focal length of eye lens to field lens is about one-half, in only one is it one-third, and in one of older construction they approach so near as seven-ninths. The general principle in regard to the interval separating the lenses is that it shall be less than the solar focus of the field lens though in the deeper oculars, and in the orthoscopic, this limit is approached or slightly exceeded. But it must be remembered that in combination with the objective the ocular receives diverging rays, and hence the actual focus of the field lens for such rays is beyond the eye lens. In the shallow oculars it will be seen that only the central portion of the eye lens is used.—*W. H. Seaman (abstract) in Nat. Mic. Congress.*

SCIENTIFIC NEWS.

— In a recent letter to Dr. Hayden, M. de Lapparent, President of the Société Geologique de France, writes that the Geological Society of France has resolved to celebrate the fiftieth anniversary of its foundation. This should properly occur on the 15th of March, but as the annual meeting takes place April 1st, the Society has decided that the two meetings shall take place at the same time. A report will be read of the part which the Society has taken in the geological progress of the last fifty years. After the meeting a banquet will be given by the French members of the Society to the foreign geologists who have been so good as to respond in person to the invitation to be present. M. de Lapparent speaks of the pleasant relations established with foreign geologists by the meeting of 1878, and hopes that these relations will be further increased in 1880, and that much may be done to render the meeting at Bologna, in 1881, still more interesting and important.

— The dispute between the Directors of the Park Commissioners and the Permanent Exhibition Company of Philadelphia having been settled to the satisfaction of both parties, the latter will at once proceed to carry out its plan as a combination of museums. The close of last year saw a balance of $16,000 in its treasury, and it is believed that next year a considerable increase in the fund available for scientific purposes, will be made.

— Mons. A. Robin (Préparateur à la Faculté des Sciences), Rue d'Ulm, 38, Paris, France, is now preparing a general work upon the anatomy of the *Chiroptera*, and wishes to obtain, either by exchange, or otherwise, American material in this order of mammals.

— According to the *Academy*, C. Kegan Paul & Co., London, have published a memoir of the late Dr. Phillip P. Carpenter, well known as an able naturalist as well as philanthropist and sanitary reformer.

— The Academy of Science at Turin has awarded a prize, amounting in value to about £480, to Mr. Charles Darwin for his discoveries in the physiology of plants.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

New York Academy of Sciences, February 16.—Dr. R. P. Stevens remarked on the geology at the head of the Ten-mile branch of the Blue river, Colorado, and Mr. W. E. Hidden exhibited and described two new meteorites from the Southern States.

March 1.—Prof. E. C. Spitzka made a communication on the brain of man and of the ape, their resemblances and their differences.

BOSTON SOCIETY OF NATURAL HISTORY, February 18.—Mr. E. R. Benton spoke on the Brighton "amygdaloid," and Dr. Wm. M. Davis on the stratified amygdales in the Brighton amygdaloid, while Prof. N. S. Shaler remarked on the origin of the various classes of lavas.

March 3.—Prof. G. H. Stone read a paper on the kames of Maine.

MIDDLESEX SCIENTIFIC FIELD CLUB, Malden, Mass, January 7. —Prof. E. A. Dolbeare, of College Hill, Mass., read a paper on radiant energy and its effects. Radiant energy, with Prof. Dolbeare, is synonymous with the terms heat, light, etc.

February 4.—Herbert A. Young, of Revere, Mass., read a paper on insectivorous plants, illustrated by diagrams.

CALIFORNIA ACADEMY OF SCIENCES, Jan. 11, 1880.—President Davidson in the chair. Mr. B. B. Redding read a paper on "The Buried Treasures of our Remote Ancestors." Prof. Davidson made a verbal communication announcing the results of the Coast Survey Expedition for the observation of the late Solar Eclipse.

Feb. 2.—President Davidson in the chair. Mr. Stillman read the chemical analysis of a secretion of the *Parrya mexicana*, the greasewood or creosote plant, caused by the puncture of an insect; also analysis of the oil of the California laurel or bay tree. J. P. Moore announced that a catalogue of the Fungi of California was about to be published by Dr. Harkness under the auspices of the Academy. Dr. Behr read a paper on the gradual change of the Flora of the San Francisco peninsula, and on the supplanting of the native growths of all countries by those of Europe and Africa, especially the former.

March 1.—Prof. David S. Jordan gave an account of the labors of the Fish Commission on the Pacific coast. Prof. Stillman read an article on the gum and coloring matter found on *Acacia greggi* and *Larrea mexicana*. There was a discussion on the Metric System.

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SELECTED ARTICLES IN SCIENTIFIC SERIALS.

THE CANADIAN ENTOMOLOGIST.—February. On certain species of Satyrus, by W. H. Edwards.

THE GEOLOGICAL MAGAZINE. — February. Mr. Hill on the cause of the glacial epoch, by James Croll.

ANNALS AND MAGAZINE OF NATURAL HISTORY.—February. On some blind Amphipoda of the Caspian sea, by Dr. Oscar Grimm.

ZEITSCHRIFT FÜR NATURWISSENSCHAFTLICHE ZOÖLOGIE.—January 23. On the development of the skull of the salamanders, by Ph. Stöhr. On the central nervous system of the crayfish, by K. R. Krieger. On the convolutions of the cerebral hemispheres of the zono-placental mammals, by J. Krueg.